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## METHOD AND APPARATUS FOR SCHEDULING ASSIGNMENT OF UPLINK PACKET TRANSMISSION IN MOBILE TELECOMMUNICATION SYSTEM

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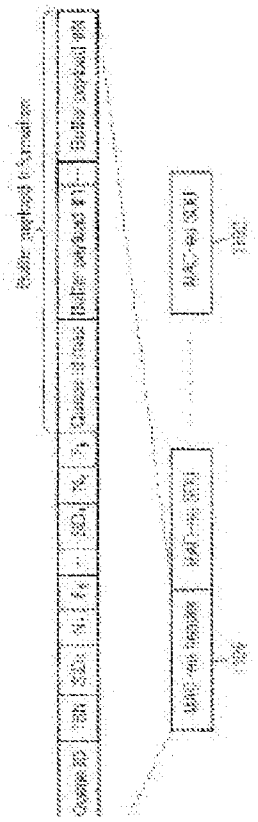
## Abstract of JP 2005073276 (A)

PROBLEM TO BE SOLVED: To provide a method and apparatus for reporting buffer status information of a buffer stored with packet data to be transmitted by a user terminal for a scheduling assignment of an uplink packet data service, in a mobile telecommunication system supporting uplink packet data service. ; SOLUTION: The terminal stores packet data, having a priority corresponding to a plurality of priority queues having inherent priorities and relating to at least one service, and transmits buffer status information, containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues. Herein, the terminal inserts the buffer status information into a header part of a protocol data unit (PDU) for the uplink packet data service, inserts the packet data into a payload part of the protocol data unit, and then transmits the protocol data unit. ; COPYRIGHT: (C)2005,JPO&NCIPI



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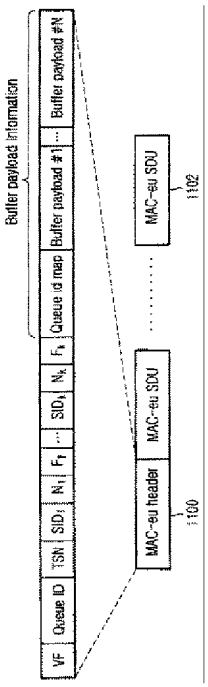
(54)【発明の名称】移動通信システムで上りリンクパケット伝送のためのスケジューリング割当方法及び装置

(57)【要約】
【課題】上りリンクパケットデータサービスを支援する移動通信システムで、該上りリンクパケットデータサービスのスケジューリング割当のために使用者端末が伝送しようとするパケットデータを格納しているバッファーのバッファー状態情報を報告する方法及び装置を提供する。
【解決手段】端末は、固有の優先順位を持ち、少なくとも一つのサービスに関連する複数の優先順位キューに、該当する優先順位を持つパケットデータを格納し、これらの優先順位キューのキュー識別子とこれらの優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報とを含むバッファー状態情報を伝送する。このときに、端末は、逆方向パケットデータサービスのためのプロトコルデータユニット(ＰＤＵ)のヘッダー部分にバッファー状態情報を挿入し、プロトコルデータユニットのペイロード部分にパケットデータを挿入して伝送する。
【選択図】図１１



【特許請求の範囲】
【請求項1】
上りリンクパケットデータサービスを支援する移動通信システムにおいて、前記上りリンクパケットデータサービスのスケジューリング割当のために、使用者端末が伝送しようとするパケットデータを格納しているバッファーのバッファー状態情報を報告する方法であって、
ａ)固有の優先順位を持ち、少なくとも一つのサービスに関連する複数の優先順位キューに、該当する優先順位を持つパケットデータを格納するステップと、
ｂ)これらの優先順位キューのキュー識別子とこれらの優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報とを含むバッファー状態情報を伝送するステップと、
を含めてなることを特徴とする方法。
【請求項2】
前記ステップｂ)は、
前記逆方向パケットデータサービスのためのプロトコルデータユニット(ＰＤＵ)のヘッダー部分に、前記バッファー状態情報を挿入し、前記プロトコルデータユニットのペイロード部分に、前記パケットデータを挿入して伝送することを特徴とする請求項１に記載の方法。
【請求項3】
前記バッファー状態情報は、
前記複数の優先順位キューのうち、格納されたデータが存在する少なくとも一つの優先順位キューを表すキュー識別子マップと、
前記キュー識別子マップが表す少なくとも一つの優先順位キューの識別子と、
前記キュー識別子マップが表す少なくとも一つの優先順位キューに格納されたデータの大きさと、
からなることを特徴とする請求項２に記載の方法。
【請求項4】
前記ヘッダー部分は、向上した逆方向専用伝送チャネル(ＥＵＤＣＨ)のためのＭＡＣ(Media Access Control)シグナリングヘッダーであることを特徴とする請求項２に記載の方法。
【請求項5】
前記使用者端末にサービスを提供する基地局から、前記バッファー状態情報に対応するスケジューリング割当情報を受信し、該スケジューリング割当情報に基づき、前記複数の優先順位キューから優先順位の高いパケットデータを優先して読み出して伝送するステップをさらに含むことを特徴とする請求項１に記載の方法。
【請求項6】
上りリンクパケットデータサービスを支援する移動通信システムにおいて、使用者端末が前記上りリンクパケットデータサービスのスケジューリング割当のためのスケジューリング情報を報告する方法であって、
前記逆方向パケットデータサービスのためにヘッダー部分とペイロード部分とから構成されたプロトコルデータユニットを生成するステップと、
前記ヘッダー部分に前記スケジューリング情報を挿入し、前記ペイロード部分に、前記逆方向パケットデータサービスのためのパケットデータを挿入して伝送するステップと、
を含むことを特徴とする方法。
【請求項7】
前記スケジューリング情報は、
固有の優先順位を持ち、少なくとも一つのサービスに関連する複数の優先順位キューを表すキュー識別子と、これらの優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報と、を含むことを特徴とする請求項６に記載の方法。

【請求項8】
前記バッファーペイロード情報は、
前記複数の優先順位キュのうち、格納されたデータが存在する少なくとも一つの優先順位キューを表すキュー識別子マップと、
前記キュー識別子マップが表す少なくとも一つの優先順位キューの識別子と、
前記キュー識別子マップが表す少なくとも一つの優先順位キューに格納されたデータの大きさと、
からなることを特徴とする請求項７に記載の方法。
【請求項9】
前記ヘッダー部分は、向上した逆方向専用伝送チャネル(ＥＵＤＣＨ)のためのＭＡＣ(Media Access Control)シグナリングヘッダーであることを特徴とする請求項６に記載の方法。
【請求項10】
前記使用者端末にサービスを提供する基地局から、前記スケジューリング情報に対応するスケジューリング割当情報を受信し、該スケジューリング割当情報に基づき、優先順位の高いパケットデータを優先して伝送するステップをさらに含むことを特徴とする請求項７に記載の方法。
【請求項11】
上りリンクパケットデータサービスを支援する移動通信システムにおいて、前記上りリンクパケットデータサービスのスケジューリング割当のために、使用者端末が伝送しようとするパケットデータを格納しているバッファーのバッファー状態情報を報告する装置であって、
同じ優先順位を持ち、少なくとも一つのサービスに関連するパケットデータを格納する複数の優先順位キューと、
これらの優先順位キューのキュー識別子と、これらの優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報とを含むバッファー状態情報を生成するスケジューリング制御器と、
前記バッファー状態情報を伝送する送信部と、
を含めてなることを特徴とする装置。
【請求項12】
前記送信部は、
前記逆方向パケットデータサービスのために、ヘッダー部分とペイロード部分とから構成されたプロトコルデータユニット(ＰＤＵ)を生成し、前記ヘッダー部分に前記バッファー状態情報を挿入し、前記ペイロード部分に、前記優先順位キューから読み出したパケットデータを挿入するプロトコルデータユニット生成器を含むことを特徴とする請求項１１に記載の装置。
【請求項13】
前記バッファー状態情報は、
前記複数の優先順位キューのうち、格納されたデータが存在する少なくとも一つの優先順位キューを表すキュー識別子マップと、
前記キュー識別子マップが表す少なくとも一つの優先順位キューの識別子と、
前記キュー識別子マップが表す少なくとも一つの優先順位キューに格納されたデータの大きさと、
からなることを特徴とする請求項１２に記載の装置。
【請求項14】
前記ヘッダー部分は、向上した逆方向専用伝送チャネル(ＥＵＤＣＨ)のためのＭＡＣ(Media Access Control)シグナリングヘッダーであることを特徴とする請求項１２に記載の装置。
【請求項15】
前記スケジューリング制御器は、

前記使用者端末にサービスを提供する基地局から、前記バッファー状態情報に対応するスケジューリング割当情報を受信し、該スケジューリング割当情報に基づき、優先順位の高いパケットデータを優先して出力するように前記優先順位キューを制御することを特徴とする請求項１１に記載の装置。

【請求項16】

上りリンクパケットデータサービスを支援する移動通信システムにおいて、使用者端末が前記上りリンクパケットデータサービスのスケジューリング割当のためのスケジューリング情報を報告する装置であって、

同じ優先順位を持ち、少なくとも一つのサービスに関連するパケットデータを格納する複数の優先順位キューと、

前記逆方向パケットデータサービスのためにヘッダー部分とペイロード部分とから構成されたプロトコルデータユニットを生成し、前記優先順位キューから出力されたパケットデータを受信し、このパケットデータのヘッダー部分に前記スケジューリング情報を挿入し、前記ペイロード部分に前記パケットデータを挿入して送信するプロトコルデータユニット生成器と、

を含めてなることを特徴とする装置。

【請求項17】

前記スケジューリング情報は、

固有の優先順位を持ち、少なくとも一つのサービスに関連する複数の優先順位キューを表すキュー識別子と、前記優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報とを含むことを特徴とする請求項１６に記載の装置。

【請求項18】

前記バッファー状態情報は、

前記複数の優先順位キューまうち、格納されたデータが存在する少なくとも一つの優先順位キューを表すキュー識別子マップと、

前記キュー識別子マップが表す少なくとも一つの優先順位キューの識別子と、

前記キュー識別子マップが表す少なくとも一つの優先順位キューに格納されたデータの大きさと、

からなることを特徴とする請求項１７に記載の装置。

【請求項19】

前記ヘッダー部分は、向上した逆方向専用伝送チャネル(ＥＵＤＣＨ)のためのＭＡＣ(Media Access Control)シグナリングヘッダーであることを特徴とする請求項１６に記載の装置。

【請求項20】

前記使用者端末にサービスを提供する基地局から、前記スケジューリング情報に対応するスケジューリング割当情報を受信し、該スケジューリング割当情報に基づき、優先順位の高いパケットデータを優先して出力するように前記優先順位キューを制御するスケジューリング制御器をさらに含むことを特徴とする請求項１７に記載の装置。

【請求項21】

移動通信システムで使用者端末からの上りリンクパケットデータサービスをスケジューリングする基地局装置であって、

前記逆方向パケットデータサービスのために、ヘッダー部分とペイロード部分とから構成されたプロトコルデータユニットを受信する受信部と、

前記プロトコルデータユニットの前記ヘッダー部分から、前記上りリンクパケットデータサービスのためのスケジューリング情報を検出し、前記ペイロード部分からパケットデータを検出するヘッダー検出部と、

前記スケジューリング情報に基づいて前記上りリンクパケットデータサービスのためのスケジューリング割当情報を生成するスケジューラと、

前記スケジューリング割当情報を前記使用者端末に送信する送信部と、

を含めてなることを特徴とする装置。

【請求項22】
前記スケジューリング情報は、
固有の優先順位を持ち、少なくとも一つのサービスに関連する複数の優先順位キューを表すキュー識別子と、前記優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報とを含むことを特徴とする請求項２１に記載の装置。
【請求項23】
前記バッファーペイロード情報は、
前記複数の優先順位キューのうち、格納されたデータが存在する少なくとも一つの優先順位キューを表すキュー識別子マップと、
前記キュー識別子マップが表す少なくとも一つの優先順位キューの識別子と、
前記キュー識別子マップが表す少なくとも一つの優先順位キューに格納されたデータの大きさと、
からなることを特徴とする請求項２２に記載の装置。
【請求項24】
前記ヘッダー部分は、向上した逆方向専用伝送チャネル(ＥＵＤＣＨ)のためのＭＡＣ(Media Access Control)シグナリングヘッダーであることを特徴とする請求項２１に記載の装置。

【発明の詳細な説明】
【技術分野】
【0001】
本発明は、移動通信システムに関し、特に、上りリンク(Uplink：ＵＬ)を通してパケットデータを伝送するためのスケジューリング割当情報を効率よく送受信する方法及び装置に関する。
【背景技術】
【0002】
非同期方式である広帯域符号分割多重接続(Wideband Code Division Multiple Access：以下、“ＷＣＤＭＡ”と称する。)通信システムでは、上りリンクを通した高速のパケットデータサービスを支援するために、向上した逆方向専用チャネル(Enhanced Uplink Dedicated Channel：以下、“ＥＵＤＣＨ”と称する。)を使用する。このＥＵＤＣＨは、非同期符号分割多重接続通信システムにおいて逆方向パケット伝送の性能を改善するために提案されたチャネルである。このようなＥＵＤＣＨ技術では、高速順方向パケット接続方式(High Speed Downlink Packet Access：以下、“ＨＳＤＰＡ”と称する。)で使用されているＡＭＣ(Adaptive Modulation and Coding)及びＨＡＲＱ(Hybrid Automatic Retransmission Request)などの既存の方法の他に、より短い伝送時間区間(transmission time interval：以下、“ＴＴＩ”と称する。)を用いる新規の技術をも使用する。また、上りリンクチャネルには基地局(Ｎｏｄｅ Ｂ)制御スケジューリングが適用される。この上りリンクに対するＮｏｄｅ Ｂ制御スケジューリングは、下りリンクに対するスケジューリングと大きな違いを持つ。
【0003】
複数個の使用者端末(User Equipment：以下、“ＵＥ”と称する。)が送信した上りリンク信号は、相互間に直交性が保持されないので、これらの上りリンク信号は相互間に干渉信号として作用する。このため、Ｎｏｄｅ Ｂが受信する上りリンク信号が増加するほど、特定ＵＥが伝送する上りリンク信号に対する干渉信号の量も増加し、よって、Ｎｏｄｅ Ｂの受信性能は低下してしまう。この種の問題は、上りリンク送信電力を増加させることで克服することができるが、この増加された送信電力を持つ上りリンク信号は、他の信号について干渉信号として作用する。したがって、前記Ｎｏｄｅ Ｂは、下記の数学式１に示すように、前記受信性能を保証しつつ受信可能な上りリンク信号の量を制限する。
【0004】
［数学式１］

ＲＯＴ＝Ｉ$_0$／Ｎ$_0$

【0005】

式中、Ｉ$_0$は、Ｎｏｄｅ Ｂの全体受信広帯域電力スペクトル密度(Power spectral density)を表し、Ｎ$_0$は、Ｎｏｄｅ Ｂの熱雑音電力スペクトル密度を表す。したがって、ＲＯＴは、Ｎｏｄｅ ＢがＥＵＤＣＨパケットデータサービスを受信するために割り当て得る上りリンク無線資源となる。

【0006】

図１Ａ及び図１Ｂは、Ｎｏｄｅ Ｂから割り当てる上りリンク無線資源の変化を示している。図１Ａ及び図１Ｂに示すように、Ｎｏｄｅ Ｂが割り当て得る上りリンク無線資源は、ＩＣＩ(Inter－cell interference)、音声トラヒック(Voice traffic)、及びＥＵＤＣＨパケットトラヒックの和で表される。

【0007】

図１Ａは、Ｎｏｄｅ Ｂ制御スケジューリングを使用しない場合の総ＲＯＴ(Total ROT)の変化を示している。前記ＥＵＤＣＨパケットトラヒックに対してスケジューリングがなされないために、複数個のＵＥが同時に高いデータレートで前記パケットデータを伝送すると、総ＲＯＴは目標ＲＯＴ(Target ROT)よりも高くなり、上りリンク信号の受信性能の劣化につながる。

【0008】

図１Ｂは、Ｎｏｄｅ Ｂ制御スケジューリングを使用する場合の総ＲＯＴの変化を示している。Ｎｏｄｅ Ｂ制御スケジューリングを使用すると、複数個のＵＥが同時に高いデータレートで前記パケットデータを伝送するのを防止することができる。すなわち、このＮｏｄｅ Ｂ制御スケジューリングは、特定のＵＥに高いデータレートを許容する場合にその他のＵＥには低いデータレートを許容することによって、総ＲＯＴが目標ＲＯＴを超えるのを防止する。したがって、このＮｏｄｅ Ｂ制御スケジューリングによれば、常に一定の受信性能が保証される。

【0009】

Ｎｏｄｅ Ｂは、前記ＥＵＤＣＨを使用するＵＥの要請データレートまたは上りリンクの送信品質を表すチャネル状況情報を用いて、各ＵＥ別にＥＵＤＣＨデータ伝送可否を通報したり、それらのＥＵＤＣＨデータレートを調整する。このＮｏｄｅ Ｂ制御スケジューリングは、移動通信システムの性能を向上させるために、これらＵＥにデータレートを割り当て、Ｎｏｄｅ Ｂの総ＲＯＴが目標ＲＯＴを越えないようにする。したがって、Ｎｏｄｅ Ｂは、遠くにあるＵＥには相対的に低いデータレートを割り当て、近くにあるＵＥには相対的に高いデータレートを割り当てる。

【0010】

図２は、ＥＵＤＣＨに対するＮｏｄｅ Ｂ制御スケジューリングの基本概念を示している。図２の２００は、ＥＵＤＣＨを支援するＮｏｄｅ Ｂを表し、２１０ないし２１６はＥＵＤＣＨを使用するＵＥを表す。あるＵＥのデータレートが高くなると、Ｎｏｄｅ ＢがこのＵＥからデータを受信する受信電力が増加し、よって、このＵＥのＲＯＴは、総ＲＯＴにおいて多い部分を占めることになる。一方、他のＵＥのデータレートが低くなると、Ｎｏｄｅ Ｂがこの他のＵＥからデータを受信する受信電力が小さくなり、よって、この他のＵＥのＲＯＴは、総ＲＯＴにおいて少ない部分を占めることになる。前記Ｎｏｄｅ Ｂは、データレートと無線資源間の関係、ＵＥが要請するデータレートを考慮して前記ＥＵＤＣＨパケットデータに対するスケジューリングを遂行する。

【0011】

図２で、ＵＥ(２１０，２１２，２１４，２１６)は、距離にしたがってＮｏｄｅ Ｂ ２００と相互に異なる逆方向送信電力でパケットデータを送信している。すなわち、Ｎｏｄｅ Ｂ ２００から最も遠く離れたＵＥ ２１０は、最も高い逆方向チャネルの送信電力２２０でパケットデータを送信し、Ｎｏｄｅ Ｂ ２００と最も近くにあるＵＥ ２１４は、最も低い逆方向チャネルの送信電力２２４でパケットデータを送信する。Ｎｏｄｅ Ｂ ２００は、総ＲＯＴを保持しながら他のセルに対するＩＣＩを減らし、かつ、移動通信シス

テムの性能を向上させるために、逆方向チャネルの送信電力の強さとデータレートが反比例するようにスケジューリングを遂行する。すなわち、逆方向チャネルの送信電力が最も高いＵＥ　２１０に対しては相対的に小さいデータレートを割り当て、逆方向チャネルの送信電力が最も低いＵＥ　２１４に対しては相対的に高いデータレートを割り当てる。

【0012】

図３は、ＥＵＤＣＨを伝送している端末３０２とこの端末３０２が属している基地局３０１間の基本的な送受信手順を示す流れ図である。

ステップＳ３０３で、基地局３０１と端末３０２間にＥＵＤＣＨの設定(setup)がなされる。この記設定ステップは、専用伝送チャネル(Dedicated Transport CHannel)を通したメッセージの伝達ステップを含む。ＥＵＤＣＨ設定が完了すると、ステップ３０４に示すように、端末３０２は、基地局３０１にスケジューリング情報を知らせる。該スケジューリング情報には、逆方向チャネル情報がわかるようにする端末送信電力情報、端末が送信しうる伝送電力余分値情報、及び端末のバッファーに蓄えられている送信すべきデータの量が含まれる。

【0013】

続いて、基地局３０１は、ステップＳ３１１で、端末のスケジューリング情報をモニタリングしながら端末３０２をスケジューリングする。このステップ３１１で、基地局３０１が、端末３０２への逆方向データ伝送を許容すると決定した場合に、ステップＳ３０５で、基地局３０１は、端末３０２に割り当てられたデータレートと伝送タイミングなどを含むスケジューリング割当情報を伝送する。このスケジューリング割当情報に応答して、端末３０２は、ステップＳ３１２でＥＵＤＣＨ伝送のための伝送率などの伝送フォーマット(ＴＦ)を決定し、この伝送フォーマットを表す伝送フォーマットリソース指示子(Transport Format Resource Indicator：以下、“ＴＦＲＩ”と称する。)を生成する。ステップＳ３０７で、端末３０２は、受信したスケジューリング割当情報を用いてＥＵＤＣＨデータを伝送する。このＥＵＤＣＨデータの伝送フォーマット(ＴＦ)を表す伝送フォーマットリソース指示子(ＴＦＲＩ)は、ステップＳ３０６で、ＥＵＤＣＨと同時に基地局３０１に伝送される。ステップＳ３１３で、基地局３０１は、受信したＴＦＲＩやＥＵＤＣＨデータに誤りがあるか判断し、ステップＳ３０８で、基地局３０１は、このＴＦＲＩ及びＥＵＤＣＨデータの一方にも誤りがある場合にはＮＡＣＫを、両方にも誤りが場合にはＡＣＫを、ＡＣＫ/ＮＡＣＫチャネルを通して端末３０２に送る。

【0014】

基地局３０１は、スケジューリング情報に基づいて端末に割り当てるデータレートを定める。このときに、基地局は、ＥＵＤＣＨを使用する多数の端末に適宜のデータレートと伝送タイミングなどを割り当て、また、前記スケジューリングにおいて逆方向のＲＯＴ値が目標ＲＯＴ値を越えないように、各端末にリソースを割り当てる。このときに、システム全体の性能向上のために、チャネル状況の良好な端末に相対的に多くのリソースを割り当てることになる。

【0015】

図４は、上りリンクパケットデータサービスのために、端末が基地局に伝送するデータの類型を示している。

図４に示すように、端末４００は、ＥＵＤＣＨを通して基地局４０２に対して、音声通話、パケットデータ、ゲームなどに関するデータを伝送することができる。このように端末が伝送するデータは、その類型によって異なるサービス品質(Quality of Service：ＱｏＳ)を要求する。したがって、基地局が、端末が伝送しようとするデータに要求されるサービス品質に応じてスケジューリングを遂行し、無線資源を割り当てる方案が望まれている現状にある。

【発明の開示】

【発明が解決しようとする課題】

【0016】

したがって、上記の問題点に鑑みて、本発明の目的は、伝送するデータに要求されるサ

ービス品質に応じて無線資源を割り当てる方法及び装置を提供することにある。
【0017】
本発明の他の目的は、高いサービス品質を要請するデータに対しては多くの無線資源を割り当て、低いサービス品質を要請するデータに対しては低い無線資源を割り当てる方法及び装置を提供することにある。
【0018】
本発明のさらに他の目的は、サービス品質に応じて異なる無線資源を割り当てることによって、移動通信システムの無線資源を効率よく使用する方法及び装置を提供することにある。
【課題を解決するための手段】
【0019】
上記の目的を達成すべく、本発明の好ましい実施形態は、上りリンクパケットデータサービスを支援する移動通信システムにおいて、前記上りリンクパケットデータサービスのスケジューリング割当のために、使用者端末が伝送しようとするパケットデータを格納しているバッファーのバッファー状態情報を報告する方法であって、固有の優先順位を持ち、少なくとも一つのサービスに関連する複数の優先順位キューに、該当する優先順位を持つパケットデータを格納するステップと、これらの優先順位キューのキュー識別子とこれらの優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報とを含むバッファー状態情報を伝送するステップと、を含めてなることを特徴とする。
【0020】
本発明の他の実施形態は、上りリンクパケットデータサービスを支援する移動通信システムにおいて、使用者端末が前記上りリンクパケットデータサービスのスケジューリング割当のためのスケジューリング情報を報告する方法であって、前記逆方向パケットデータサービスのためにヘッダー部分とペイロード部分とから構成されたプロトコルデータユニットを生成するステップと、前記ヘッダー部分に前記スケジューリング情報を挿入し、前記ペイロード部分に、前記逆方向パケットデータサービスのためのパケットデータを挿入して伝送するステップと、を含むことを特徴とする。
【0021】
本発明のさらに他の実施形態は、上りリンクパケットデータサービスを支援する移動通信システムにおいて、前記上りリンクパケットデータサービスのスケジューリング割当のために、使用者端末が伝送しようとするパケットデータを格納しているバッファーのバッファー状態情報を報告する装置であって、同じ優先順位を持ち、少なくとも一つのサービスに関連するパケットデータを格納する複数の優先順位キューと、これらの優先順位キューのキュー識別子と、これらの優先順位キューに格納されているパケットデータの量を表すバッファーペイロード情報とを含むバッファー状態情報を生成するスケジューリング制御器と、前記バッファー状態情報を伝送する送信部と、を含めてなることを特徴とする。
【0022】
本発明のさらに他の実施形態は、上りリンクパケットデータサービスを支援する移動通信システムにおいて、使用者端末が前記上りリンクパケットデータサービスのスケジューリング割当のためのスケジューリング情報を報告する装置であって、同じ優先順位を持ち、少なくとも一つのサービスに関連するパケットデータを格納する複数の優先順位キューと、前記逆方向パケットデータサービスのためにヘッダー部分とペイロード部分とから構成されたプロトコルデータユニットを生成し、前記優先順位キューから出力されたパケットデータを受信し、このパケットデータのヘッダー部分に前記スケジューリング情報を挿入し、前記ペイロード部分に前記パケットデータを挿入して送信するプロトコルデータユニット生成器と、を含めてなることを特徴とする。
【0023】
本発明のさらに他の実施形態は、移動通信システムで使用者端末からの上りリンクパケットデータサービスをスケジューリングする基地局装置であって、前記逆方向パケットデータサービスのために、ヘッダー部分とペイロード部分とから構成されたプロトコルデー

タユニットを受信する受信部と、前記プロトコルデータユニットの前記ヘッダー部分から、前記上りリンクパケットデータサービスのためのスケジューリング情報を検出し、前記ペイロード部分からパケットデータを検出するヘッダー検出部と、前記スケジューリング情報に基づいて前記上りリンクパケットデータサービスのためのスケジューリング割当情報を生成するスケジューラと、前記スケジューリング割当情報を前記使用者端末に送信する送信部と、を含めてなることを特徴とする。

【発明の効果】

【0024】

本発明は、端末から、向上した上りリンクチャネルを通して要求される優先順位の異なるデータを同時に伝送するときに、このデータの優先順位を基地局制御スケジューリングで反映する。このために、端末がサービス品質に対応する優先順位キューのバッファー状態情報を伝達し、基地局は伝えられた優先順位キューのバッファー状態情報を用いてスケジューリングを遂行する。したがって、本発明によれば、要求される優先順位に対応する差別化したサービスを提供することができ、使用者の要求を充足させることが可能になる。

【発明を実施するための最良の形態】

【0025】

以下、本発明の好ましい実施形態について、添付図面を参照しつつ詳細に説明する。なお、本発明を説明するにあたり、関連する公知機能や構成についての具体的な説明が本発明の要旨を曖昧にするのを避けるために、その詳細な説明は省略する。

【0026】

第３世代移動通信の一つであるＵＭＴＳ(Universal Mobile Telecommunication Service)システムは、ＧＳＭ(Global System for Mobile communication)とＧＰＲＳ(General Packet Radio Services)通信標準に基盤を置いているが、ＴＤＭＡ(Time Division Multiple Access)を使用するＧＳＭとは違い、広帯域(Wideband)ＣＤＭＡ技術を使用する。ＵＭＴＳシステムの無線接続ネットワーク(UMTS Terrestrial Radio Access Network：以下、“ＵＴＲＡＮ”と称する。)は、複数のセルを含む基地局とこれらの基地局の無線資源を管理する無線ネットワーク制御器(Radio Network Controller：以下、“ＲＮＣ”と称する。)を含めて構成される。

【0027】

端末とＲＮＣ間のインターフェースは、Ｕｕインターフェースと称し、制御及びシグナリング信号を交換するための制御平面(Control Plane)と、データトラヒックを伝送するための使用者平面(User Plane)とに区分される。前記制御平面にはＲＲＣ(Radio Resource Control)階層、ＲＬＣ(Radio Link Control)階層、ＭＡＣ(Media Access Control)階層、及び物理(Physical：以下、“ＰＨＹ”と称する。)階層が存在し、使用者平面には、ＰＤＣＰ(Packet Data Control Protocol)階層、ＲＬＣ階層、ＭＡＣ階層、及び物理階層が存在する。ここで、物理階層は各セルに位置し、ＭＡＣ階層からＲＲＣ階層までは、ＲＮＣに位置する。

【0028】

特に、ＭＡＣ階層において、使用者平面と関連する部分は、ＭＡＣ－ｄと呼ばれ、制御平面に関連する部分は、ＭＡＣ－ｃと呼ばれる。専用伝送チャネルを通して伝送しようとする使用者データは、ＭＡＣ－ｄ階層を通して所望の大きさの伝送ブロックに生成される。使用者データをＥＵＤＣＨを通して伝送しようとする場合、伝送ブロックはＭＡＣ階層でＭＡＣ－ｅｕ部分を経ることになる。ＭＡＣ－ｅｕ階層は、ＭＡＣ－ｄ階層から送られてきたデータを物理階層に伝達するに先立って、ＥＵＤＣＨのための基地局制御スケジューリング、ＨＡＲＱなどの処理を担う。

【0029】

図５は、本発明の好ましい実施形態によって、ＥＵＤＣＨを伝送する端末のＭＡＣ－ｅｕ階層構造を示す図である。

端末のＭＡＣ－ｅｕ階層５００は、順位分配器(Priority Queue distributor)５０２と

、優先順位キュー(Priority Queue：ＰＱ)５０４とを含む。このＭＡＣ－ｅｕ階層５００は、ＭＡＣ－ｄ階層５１８から基地局に伝送するデータを受信する。この受信データは、ＭＡＣ－ｅｕ階層５００の順位分配器５０２に伝えられるし、この順位分配器５０２は、受信したデータに対する優先順位を決定した後に、その優先順位に対応する優先順位キュー５０４にバッファリングする。

【0030】

これらの優先順位キュー５０４は、提供しようとするサービスの優先順位にしたがってデータを格納するのに使用され、それぞれ固有のキュー識別子(Queue Identifier)を持つ。すなわち、これらの優先順位キュー５０４はそれぞれ、少なくとも一つのサービスにそれぞれ関連され、相互に異なる優先順位を持つデータを格納する。図５では二つの優先順位キュー５０４が示されているが、提供しているサービスの種類と個数に対応するＭＡＣ制御信号５１６に応じて、優先順位キュー５０４の個数は任意に決定される。すなわち、基地局に伝達するデータに対する優先順位を多段階に構成しようとする場合には、これら優先順位キュー５０４の個数は増加する。この優先順位は、データを基地局に伝送する伝送時点、すなわち要求される遅延によって決定される。つまり、基地局に早い時間内に伝送すべきデータは、優先順位が高く、基地局に早い時間内に伝送しなくてもいいデータは、優先順位が低い。

【0031】

順位分配器５０２は、受信したデータに対する優先順位を決定し、この決定された優先順位に対応する優先順位キュー５０４にそのデータを伝達する。これにより、同じ優先順位を持つデータは、同一の優先順位キューに伝えられる。これらの優先順位キュー５０４は、基地局からスケジューリングによりリソースが割り当てられるまで、受信データを格納する。

【0032】

ＭＡＣ－ｅｕ階層５００は、基地局にスケジューリング割当を要請するために、これらの優先順位キュー５０４に格納されたデータの量を表すバッファー状態情報と、上りリンクの送信品質を表すチャネル状態情報を含むスケジューリング情報とを、ＥＵＤＣＨ関連上りリンク５１０を通して伝送する。基地局が、ＥＵＤＣＨ関連下りリンク５１４を通して端末にスケジューリング割当情報を伝送すると、このスケジューリング割当情報を用いてＴＦＣ(TF Combination)選択部５０８はＴＦＣを決定し、この決定されたＴＦＣを用いて、優先順位キュー５０４からデータを読み出してＥＵＤＣＨ(５１２)を通して伝送する。この場合に、端末は、優先順位の高い優先順位キュー５０４に格納されているデータをまず伝送する。こうすると、優先順位に応じて伝送時間を異なって指定することが可能になる。一方、ＨＡＲＱ個体５０６は、受信したデータに対して、関連下りリンク５１４を通して受信されるＡＣＫ/ＮＡＣＫを解析し、ＡＣＫが受信される場合には該当の優先順位キューに格納されたデータを廃棄し、ＮＡＣＫが受信される場合には当優の先順位キューに格納されたデータを再伝送する。

【0033】

図６は、本発明の一実施形態によって二つの端末が一つの基地局にスケジューリング割当を要請する動作に示している。

図６において、端末１(６１０)は、二つの優先順位キュー６１２，６１４を含み、端末２(６２０)は、一つの優先順位キュー６２２を含んでいる。端末１(６１０)の優先順位キュー１(６１２)は、優先順位キュー２(６１４)に比べて高い優先順位を持ち、端末２(６２０)の優先順位キュー１(６２２)は、端末１(６１０)の優先順位キュー１(６１２)と同じ優先順位を持つ。端末１(６１０)の優先順位キュー１(６１２)は、１００ビットのデータを格納しており、端末１(６１０)の優先順位キュー２(６１４)は、３００ビットのデータを格納している。また、端末２(６２０)の優先順位キュー１(６２２)は、３００ビットのデータを格納している。この基地局(６００)は、４５０ビットだけのデータを受信しうるような無線資源を持つ。

【0034】

図６を参照すると、端末６１０，６２０は、基地局６００に伝送するデータの量を表すバッファー状態情報６３０，６３２を伝送する。すなわち、端末１(６１０)は、４００ビットに対応するバッファー状態情報６３０を基地局６００に伝送し、端末２(６２０)は、３００ビットに対応するバッファー状態情報６３２を基地局６００に伝送する。この場合に、これらの端末６１０，６２０の上りリンクチャネル状況が同一であると、基地局６００は、端末１(６１０)に対しては、２００ビットだけを伝送することを許容するスケジューリング割当情報(６４０)を伝送し、端末２(６２０)に対しては、１５０ビットだけを伝送することを許容するスケジューリング割当情報(６４２)を伝送する。

【0035】

端末１(６１０)は、スケジューリング割当情報６４０を用いてＴＦＣを決定し、この決定されたＴＦＣを用いてＥＵＤＣＨを通してデータを伝送する。すなわち、優先順位にしたがって、まず、優先順位キュー１(６１２)に待機している１００ビットのデータが伝送され、優先順位キュー２(６１４)に待機している１００ビットのデータが伝送される。端末２(６２０)もまた、スケジューリング割当情報(６４２)を用いてＴＦＣを決定し、この決定されたＴＦＣを用いてＥＵＤＣＨを通してデータを伝送する。すなわち、優先順位キュー１(６２２)に待機している１５０ビットのデータが伝送される。

【0036】

この場合に、端末２(６２０)の優先順位キュー１(６２２)は、端末１の優先順位キュー２(６１４)よりも高い優先順位を持つにもかかわらず、その待機している全てのデータを伝送することができない。すなわち、基地局(６００)に対してスケジューリング割当情報を要請する端末が一つである場合には、優先順位にしたかって待機しているデータを伝送すればいいが、基地局に対してスケジューリング割当情報を要請する端末が少なくとも二つである場合には、相対的に高い優先順位を持つデータが、後で伝送される、という問題点が生じる。

【0037】

そこで、図７では、図６の問題点を解決するための本発明の好ましい実施形態を提示している。図７で、端末７１０，７２０は、データの量のみならず、優先順位に関する情報も同時に基地局７００に伝送する。

【0038】

図７を参照すると、端末１(７１０)は、二つの優先順位キュー７１２，７１４を含み、端末２(７２０)は、一つの優先順位キュー７２２を含んでいる。端末１(７１０)の優先順位キュー１(７１２)は、優先順位キュー２(７１４)に比べて高い優先順位を持ち、端末２(７２０)の優先順位キュー１(７２２)は、端末１(７１０)の優先順位キュー１(７１２)と同じ優先順位を持つ。端末１(７１０)の優先順位キュー１(７１２)は、１００ビットのデータを格納しており、端末１(７１０)の優先順位キュー２(７１４)は、３００ビットのデータを格納している。また、端末２(７２０)の優先順位キュー１(７２２)は、３００ビットのデータを格納している。

【0039】

端末７１０，７２０は、基地局(７００)に伝送するデータの量と優先順位に関する情報とを含むバッファー状態情報７３０，７３２を伝送する。すなわち、端末１(７１０)は、４００ビットに対応するデータ量と優先順位を表すキュー識別子(Queue Identification：ＱＩＤ)とを含むバッファー状態情報７３０を、基地局７００に伝送する。このバッファー状態情報７３０は、優先順位１に対応するデータ量が１００ビットであり、優先順位２に対応するデータ量が３００ビットであるのを表す。端末２(７２０)は、３００ビットに対応するデータ量と優先順位を表すＱＩＤとを含むバッファー状態情報７３２を、基地局７００に伝送する。これらの端末７１０，７２０に対する上りリンクチャネル状況が同一であれば、基地局７００は、優先順位を考慮して端末７１０，７２０にスケジューリング割当情報７４０，７４２を伝送する。このときに、基地局７００は、端末１(７１０)に対しては、１００ビットだけを伝送することを許容するスケジューリング割当情報７４０を伝送し、端末２(７２０)に対しては、２５０ビットだけを伝送することを許容するスケ

ジューリング割当情報７４２を伝送する。

【0040】

端末１(７１０)は、スケジューリング割当情報７４０を用いてＴＦＣを決定し、この決定されたＴＦＣを用いてＥＵＤＣＨを通してデータを伝送する。すなわち、優先順位にしたがって、優先順位キュー１(７１２)に待機している１００ビットのデータが伝送される。端末２(７２０)もまた、スケジューリング割当情報(７４２)を用いてＴＦＣを決定し、この決定されたＴＦＣを用いてＥＵＤＣＨを通してデータを伝送する。すなわち、優先順位キュー１(７２２)に待機している２５０ビットのデータが伝送される。このように端末１(７１０)と端末２(７２０)は、優先順位が高いデータを先に伝送する。

【0041】

図８は、本発明の好ましい実施形態に従う端末のＭＡＣ－ｅｕスケジューリング制御器の構造を示す図である。

図８を参照すれば、スケジューリング制御器(Scheduling Controller)８００は、環境制御器(Configuration Controller)８０４、優先順位キュー制御器(PQ Controller)８０２、及びＴＦＣ選択部８０６で構成されている。優先順位キュー制御器８０２は、優先順位キュー(図示せず)からバッファーペイロード情報８１０，８１２を受ける。このバッファーペイロード情報８１０，８１２は、各優先順位キューに待機しているデータの量を意味する。図８では、ｎ個の優先順位キューがあると仮定している。参照番号８１０は、優先順位キュー１から送られてくるバッファーペイロード情報であり、参照番号８１２は、優先順位キューｎから送られてくるバッファーペイロード情報である。また、優先順位キュー制御器８０２は、環境制御器８０４からキュー情報８１４が入力される。このキュー情報８１４は、優先順位キューの設定情報(configurationin formation)であって、優先順位キューのメモリーの大きさと個数に関連する。優先順位キュー制御器８０２は、バッファーペイロード情報８１０，８１２と該当のバッファーペイロード情報の優先順位に関するＱＩＤを含むバッファー状態情報８２６とを、ＥＵＤＣＨ送信部８２８を介して基地局に伝送する。

【0042】

ＴＦＣ選択部８０６は、Ｅ－ＳＣＣＨ(Shared Control Channel for EUDCH)(図示せず)を通してスケジューリング割当情報８２０が入力される。また、このＴＦＣ選択部８０６は、優先順位キュー制御器８０２から優先順位キューに対するバッファー状態情報８１６入力され、環境制御器８０４からスケジューリング環境(configuration)情報が入力される。このスケジューリング環境情報には、優先順位キューの優先順位やＴＦＣＳ(Transport Format Combination Set)などが含まれる。ＴＦＣ選択部８０６は、バッファー状態情報８１６とスケジューリング割当情報８２０を用いてＴＦＣを決定する。ＴＦＣは、優先順位の高い優先順位キューに格納されているデータを先に伝送するように決定される。

【0043】

この決定されたＴＦＣを、ＴＦＣ選択部８０６は、Ｅ－ＤＰＤＣＨ(Dedicated Physical Data Channel for EUDCH)送信部８２４に伝達する。Ｅ－ＤＰＤＣＨ送信部８２４は、この受信したＴＦＣを用いてＥＵＤＣＨパケットデータを伝送する。前記決定されたＴＦＣは、Ｅ－ＤＰＣＣＨ(Dedicated Physical Control Channel for EUDCH)送信部８２２に伝えられる。Ｅ－ＤＰＣＣＨ送信部８２２は、ＴＦＣを含む制御情報を、ＥＵＤＣＨパケットデータと同一の時点で伝送する。また、このＴＦＣは、優先順位キュー制御器８０２に伝えられる。優先順位キュー制御器８０２は、受信したＴＦＣを用いて、どの優先順位キューに待機しているデータが伝送されたか把握し、優先順位キューのバッファー状態を更新する。

【0044】

図９は、本発明の好ましい実施形態に従うＭＡＣ－ｅｕスケジューリング制御器の動作を示すフローチャートである。

図９を参照すると、ステップＳ９００で、スケジューリング制御器は、優先順位キューから入力されるバッファーペイロード情報に基づいて、優先順位キューに新規のデータが

到達したか否かを判断する。このスケジューリング制御器は、どの優先順位キューからバッファーペイロード情報が入力されたかを判断することによって、優先順位キューに伝送されたデータの量と優先順位が分かる。これらの優先順位キューに新規のデータが到達された場合にはステップＳ９０２に移行し、優先順位キューに新規のデータが到達しなかった場合には、ステップＳ９００に戻る。

【0045】

ステップＳ９０２で、スケジューリング制御器は、バッファーペイロード情報とバッファーペイロード情報に関連した優先順位を表すキュー識別子とを含むバッファー状態情報を、基地局に伝送する。

【0046】

ステップＳ９０４で、スケジューリング制御器は、基地局からスケジューリング割当情報が受信されるか否かを判断する。このスケジューリング割当情報には、端末が使用可能な最大データレートと許容タイミングに関する情報が含まれる。基地局からスケジューリング割当情報が受信された場合には、ステップＳ９０６に移行し、スケジューリング割当情報が受信されなかった場合には、ステップＳ９０４に復帰する。

【0047】

ステップＳ９０６で、スケジューリング制御器は、スケジューリング割当情報により割り当てられたデータレート内でＴＦＣを決定する。このＴＦＣを決定するにおいて、優先順位キューに伝送されたデータの優先順位を考慮し、高い優先順位を持つデータが先に伝送されるようにする。ステップＳ９０８で、スケジューリング制御器は、決定されたＴＦＣを用いて、優先順位キューに伝送されたデータを伝送するように制御する。この制御命令に応じてＭＡＣ－ｅｕ階層は、該当の優先順位キューから読み出したデータを含むＭＡＣ－ｅｕ　ＰＤＵ(Protocol Data Unit)を生成し、この生成されたＭＡＣ－ｅｕ　ＰＤＵを、Ｅ－ＤＰＤＣＨを通して伝送する。図９には図示せぬが、スケジューリング制御器は、決定されたＴＦＣをＥ－ＤＰＣＣＨを通して伝送し、変更されたバッファー状態情報に関する情報を更新する。この更新されたバッファー状態情報は、ＥＵＤＣＨを通して伝送される。

【0048】

図１０は、本発明の好ましい実施形態に従う、端末と基地局間のＭＡＣ－ｅｕシグナリングを示す図である。図１０に示すように、端末のＭＡＣ－ｅｕ階層１０００は、基地局のＭＡＣ－ｅｕ階層１００２にバッファー状態情報を伝送している。このバッファー状態情報は、上にも述べたように、キュー識別子と優先順位キューのバッファーペイロードを含む。

【0049】

図１１は、本発明の好ましい実施形態によってバッファー状態情報を含むＭＡＣ－ｅｕ　ＰＤＵの構成を示す図である。図１１に示すように、ＭＡＣ－ｅｕ　ＰＤＵは、ヘッダー部分に受納されるＭＡＣ－ｅｕヘッダー１１００と、ペイロード部分に受納される複数個のＭＡＣ－ｅｕ　ＳＤＵ(Service Data Unit)１１０２とから構成される。ＭＡＣ－ｅｕヘッダー１１００に含まれる情報は、下記の通りである。

【0050】

バージョンフラグ(Version Flag：ＶＦ)は、ＭＡＣ－ｅｕ　ＰＤＵフォーマットのバージョンを表す。

キュー識別子(ＱＩＤ)は、ＭＡＣ－ｅｕ　ＳＤＵが出力された優先順位キューの識別子であって、３ビットで構成される。

伝送シーケンス番号(Transmission Sequence Number：ＴＳＮ)は、優先順位にしたがってＭＡＣ－ｅｕ　ＳＤＵを再整列するための一連番号であって、５ビット乃至６ビットで構成される。

ＳＩＤ＿ｋは、ＭＡＣ－ｅｕ　ＰＤＵを構成するＭＡＣ－ｅｕ　ＳＤＵの集合のうち、ｘ番目のＭＡＣ－ｅｕ　ＳＤＵ集合に属するＭＡＣ－ｄ　ＳＤＵの大きさを表し、２ビット乃至３ビットで構成される。

Ｎ＿ｋは、ｘ番目のＭＡＣ－ｅｕ　ＳＤＵ集合に属するＭＡＣ－ｄ　ＰＤＵの個数を表し、７ビットで構成される。

Ｆ(Flag)は、１に設定されると、続くフィールドがＭＡＣ－ｅｕ　ＰＤＵであることを表し、Ｆが０に設定されると、続くフィールドがＳＩＤであることを表す。

キュー識別子マップ(QID map)は、データが存在する優先順位キューの識別子を表すマップであって、優先順位キューの個数だけのビット数が割り当てられる。１は、データが存在することを表し、０は、データが存在しないことを表す。バッファーペイロード(buffer payload)は、キュー識別子マップの値が１の優先順位キューに格納されたデータの大きさを表し、キュー識別子マップの長さによるビット数が割り当てられる。

【0051】

図１２は、本発明の好ましい実施形態に従う基地局のＭＡＣ－ｅｕスケジューラの構造を示す図である。

図１２を参照すると、スケジューラ１２００は、端末状態分析器(UE status Analyzedr)１２０２とリソース制御器１２０４とから構成される。端末状態分析器１２０２は、基地局が管理するセル領域にある端末ＵＥ#１，ＵＥ#２，ＵＥ#Ｎのバッファー状態情報とチャネル状態情報１２１０，１２１２，１２１４を受信する。端末状態分析器１２０２は、各端末が伝送したＭＡＣ－ｅｕ　ＰＤＵのＭＡＣ－ｅｕヘッダーに含まれている優先順位キューに従うバッファー状態情報を受け、これに基づいて各端末の優先順位キューに格納されたデータの量を推定する。端末状態分析器１２０２は、各端末に対するデータ量推定値をリソース制御器１２０４に伝達する。

【0052】

リソース制御器１２０４は、各端末に対するデータ量推定値、チャネル状態情報、及び無線網制御器からＮＢＡＰ(Node B Application Protocol)を通じて提供されたターゲットＲＯＴを考慮して、特定端末に割り当てるＲＯＴを計算し、端末の優先順位キューの優先順位を考慮して、この端末に割り当てる最大許容データレートを決定する。ＴＦＣが決定されると、端末から伝送可能なデータの大きさと伝送電力のオフセットが前記ＴＦＣによって決定される。各端末に割り当てる最大許容データレートは、最大許容ＴＦＣ情報１２２０，１２２２に含まれ、Ｅ－ＳＣＣＨ送信部１２２４，１２２６を介して端末に伝送される。

【0053】

図１３は、本発明の好ましい実施形態に従う基地局のＭＡＣ－ｅｕスケジューラの動作を示すフローチャートである。

図１３を参照すると、ステップＳ１３００で、スケジューラは、端末からスケジューリング情報を含むＭＡＣ－ｅｕ　ＰＤＵが受信されたか否かを判断する。このスケジューリング情報は、各端末のバッファーペイロード情報と各バッファーの優先順位に関する情報とを含む。この判断結果、スケジューリング情報が受信された場合には、ステップＳ１３０２に移行し、スケジューリング情報が受信されなかった場合にステップＳ１３００に復帰する。

【0054】

ステップＳ１３０２で、スケジューラは、端末から受信したバッファー状態情報とチャネル情報に基づいて、この端末に割り当てる最大許容データレートを決定する。この最大許容データレートは、無線網制御器から提供されたターゲットＲＯＴ及び端末が伝送するデータの優先順位を考慮して決定する。この最大許容データレートは、ステップＳ１３０４段階でＥＵＤＣＨに関連した制御チャネルを通して端末に伝送される。

【0055】

図１４は、本発明の好ましい実施形態に従う端末の送受信動作の構造を示す図である。まず、スケジューリング割当情報を受信する受信側における動作について述べる。

図１４を参照すると、アンテナから入力された受信信号は、ＲＦ(Radio Frequency)部(RF Unit)１４４２を経て基底帯域信号に変換された後に、デスクランブラ１４００に入力される。デスクランブラ１４００は、受信した基底帯域信号を、スクランブリングコード

$S_{d1,n}$を使ってディスクランブリングする。ディスクランブリングされた信号は、逆拡散器１４０２に送られる。このディスクランブリングされた信号をチャネル区分(channelization)するために、逆拡散器１４０２は、このディスクランブリングされた信号にチャネルコード(Channelization Code)$C_{es}$を乗じ、チャネル区分された信号を復調部１４０４に伝達する。チャネル区分された信号は、復調部１４０４で復調された後に、デコーディング部１４０６でデコーディングされる。Ｅ－ＳＣＣＨ検出部１４０８は、デコーディングされた信号からスケジューリング割当情報を検出する。このスケジューリング割当情報は、端末に割り当てられた最大許容ＴＦＣ情報１４１０を含む。

【0056】

最大許容ＴＦＣ情報１４１０は、ＭＡＣ－ｅｕスケジューリング制御器１４１２に伝えられる。ＭＡＣ－ｅｕスケジューリング制御器１４１２は、最大許容ＴＦＣ情報１４１０を用いてＴＦＣを決定する。このＴＦＣは、優先順位キュー１４２２，１４２４に待機しているデータの優先順位に関する情報を考慮して決定する。このために、優先順位キュー１４２２，１４２４は、相互に異なる優先順位を持つ少なくとも一つのサービスに関連したデータを格納し、新規のデータが到達する度にまたは周期的にキュー識別子とバッファーペイロード情報をＭＡＣ－ｅｕスケジューラ制御器１４１２に伝達する。ＭＡＣ－ｅｕスケジューラ制御器１４１２は、前記決定されたＴＦＣに関する情報を、Ｅ－ＤＰＣＣＨ生成器１４１４に伝達する。Ｅ－ＤＰＣＣＨ生成器１４１４は、他の制御情報とＴＦＣとを含む制御信号を生成する。この生成された制御信号は、コーディング部１４１６でコーディングされた後に、変調部１４１８で変調され、チャネルコード$C_{ec}$を用いて拡散器１４２０でチャネル区分(channelization)された後に、多重化器１４３８に伝えられる。

【0057】

ＭＡＣ－ｅｕ　ＰＤＵ生成器１４２８は、２つの機能を遂行する。その一つは、前記ＭＡＣ－ｅｕスケジューリング制御器１４１２から伝達されたキュー識別子とバッファー状態情報を、ＭＡＣ－ｅｕヘッダーに含ませる。また、スケジューリング制御器１４１２から伝達されたＴＦＣを用いて、優先順位キュー１４２２，１４２４に待機しているデータにＭＡＣ－ｅｕヘッダーを添付することで、ＭＡＣ－ｅｕ　ＰＤＵを生成する。このＭＡＣ－ｅｕ　ＰＤＵは、コーディング部１４３０でコーディングされ、レートマッチング部１４３２でレートマッチングされる。このレートマッチングされた信号は、変調部１４３４で変調され、拡散器１４３６でチャネルコード$C_e$によりチャネル区分(Channelization)される。このチャネルコーディングされたデータは、多重化器１４３８に伝えられる。この多重化器１４３８は、拡散器１４２０，１４３６から伝達された信号と他のチャネルの信号を多重化する。これら多重化された信号は、スクランブラー１４４０によりスクランブリングコード$S_{dpch,n}$によりスクランブリングされた後に、ＲＦ部１４４４でＲＦ信号に変換され、アンテナから基地局へ伝送される。

【0058】

図１５は、本発明の好ましい実施形態に従う基地局の送受信動作の構造を示す図である。まず、スケジューリング情報を受信する受信側における動作について述べる。基地局の受信部は、上りリンクパケットデータサービスを遂行するＮ個の端末それぞれに対応するＮ個の受信経路１５４０，１５４２を持つ。ここでは、ＵＥ#１に対応する受信経路１５４０の動作について説明するが、残りの受信経路も同様の動作を遂行することは言うまでもない。

【0059】

アンテナから伝えられた受信信号は、ＲＦ部１５３８を経て基底帯域信号に変換された後に、デスクランブラ１５１８に入力される。デスクランブラ１５１８は、基底帯域信号をスクランブリングコード$S_{dpch,n}$によりディスクランブリングする。このディスクランブリングされた信号は、逆拡散器１５２０，１５２２に伝えられてＥ－ＤＰＣＣＨ信号とＥ－ＤＰＤＣＨ信号とにチャネル区分される。逆拡散器１５２２でチャネルコード$C_{ec}$によりチャネル区分されたＥ－ＤＰＣＣＨ信号は、復調部１５２４で復調された後に、デコーディング部１５２６でデコーディングされる。続いて、制御情報検出部１５２７は、デ

コーディング部１５２６でデコーディングされたデータから、ＥＵＤＣＨデータを受信する上で必要な制御情報を検出する。この制御情報は、ＥＵＤＣＨデータの変調情報などを含む。

【0060】

逆拡散器１５２０でチャネルコード$C_e$により逆拡散されたＥ－ＤＰＤＣＨは、復調部１５２８で、制御情報検出部１５２７で検出された変調情報により復調され、レートデマッチング部１５３０によりデマッチングされた後に、デコーディング部１５３２でデコーディングされる。

【0061】

ＭＡＣ－ｅｕヘッダー検出部１５３４は、デコーディング部１５３２から伝えられたＭＡＣ－ｅｕ　ＰＤＵでヘッダー内のバッファー状態情報とペイロード内のデータを分割する。ＭＡＣ－ｅｕヘッダー検出部１５３４は、ＭＡＣ－ｅｕヘッダー内のキュー識別子マップ(QID map)が０でない値を持っていれば、ＭＡＣ－ｅｕヘッダーに含まれているバッファー状態情報１５１６を検出してＭＡＣ－ｅｕスケジューラ１５１４に伝達する。このバッファー状態情報１５１６は、少なくとも一つのキュー識別子とバッファーペイロード情報とから構成される。また、ＭＡＣ－ｅｕヘッダー検出部１５３４は、ＭＡＣ－ｅｕヘッダー以外の部分であるＭＡＣ－ｅｕ　ＳＤＵを分離し、これらを上位階層の再整列バッファー(Reordering Buffer)(図示せず)に伝達する。これらの再整列バッファーは、ＲＮＣ内に位置し、かつ、端末側の優先順位キューと対応して、受信されるＭＡＣ－ｅｕ　ＳＤＵをそれらの伝送シーケンス番号(ＴＳＮ)にしたがって整列する。

【0062】

ＭＡＣ－ｅｕスケジューラ１５１４は、バッファー状態情報１５１６と他のスケジューリング情報を用いて、各端末のための最大許容ＴＦＣ情報１５１２を生成し、この最大許容ＴＦＣ情報１５１２をＥ－ＳＣＣＨ生成器１５１０に伝達する。この最大許容ＴＦＣは、バッファー状態情報に含まれている、伝送するデータに対する優先順位を考慮して決定される。Ｅ－ＳＣＣＨ生成器１５１０は、前記最大許容ＴＦＣ情報に対するスケジューリング割当情報を生成する。このスケジューリング割当情報は、コーディング部１５０８によりコーディングされ、変調部１５０６により変調される。変調部１５０６により変調された信号は、拡散器１５０４でチャネルコード$C_{es}$によりチャネル区分された後に、多重化器１５０２に伝えられる。このチャネル区分された信号は、多重化器１５０２で他の下りリンクチャネル信号と多重化される。この多重化された信号は、スクランブラー１５００でスクランブリングコード$S_{d1,n}$によりスクランブリングされた後に、ＲＦ部１５３６によりＲＦ信号に変換された後に、アンテナから端末に伝送される。

【0063】

一方、本発明の詳細な説明では具体例について説明してきたが、本発明の範囲を逸脱しない限度内で各種の変形が可能であることは勿論である。したがって、本発明の範囲は、上述の具体例に限定されてはいけなく、特許請求の範囲及びこの範囲と均等なものにより定められるべきである。

【図面の簡単な説明】

【0064】

【図1A】基地局制御スケジューリングを使用しない場合の基地局の上りリンク無線資源の変化を示す図である。

【図1B】基地局制御スケジューリングを使用する場合の基地局の上りリンク無線資源の変化を示す図である。

【図2】上りリンクパケット伝送を遂行する使用者端末と基地局を示す図である。

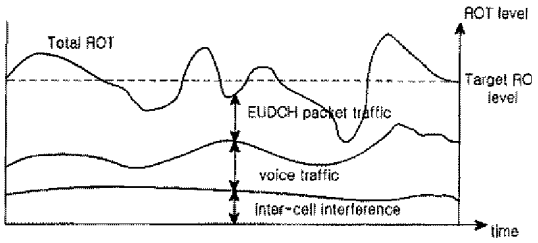
【図3】上りリンクパケット伝送を遂行するために使用者端末と基地局間に送受信される情報を示す図である。

【図4】上りリンクパケットデータサービスのために端末から基地局へ伝送するデータの類型を示す図である。

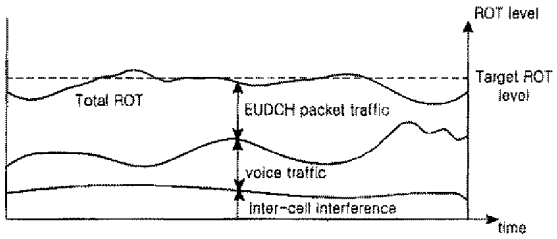
【図5】本発明の好ましい実施形態に従う端末の論理階層構造を示す図である。

【図6】本発明の一実施形態に従う端末と基地局間のスケジューリング割当情報の送受信を示す図である。
【図7】本発明の他の実施形態に従う端末と基地局間のスケジューリング割当情報の送受信を示す図である。
【図8】本発明の好ましい実施形態に従う端末の論理階層構造を示す図である。
【図9】本発明の好ましい実施形態によって端末の論理階層構造で遂行される動作を示すフローチャートである。
【図10】本発明の好ましい実施形態によって端末の論理階層から基地局の論理階層へバッファー状態情報を伝送する動作を示すメッセージ流れ図である。
【図11】本発明の好ましい実施形態によって端末のバッファー状態情報を伝送するＥＵＤＣＨデータの構造を示す図である。
【図12】本発明の好ましい実施形態に従う基地局の論理階層構造を示す図である。
【図13】本発明の好ましい実施形態によって基地局の論理階層構造で遂行される動作を示すフローチャートである。
【図14】本発明の好ましい実施形態に従う端末の送受信構造を示す図である。
【図15】本発明の好ましい実施形態に従う基地局の送受信構造を示す図である。
【符号の説明】
【0065】
５００・・・ＭＡＣ－ｅｕ階層
５０２・・・順位分配器
５０４・・・優先順位キュー(Priority Queue：ＰＱ)
５０６・・・ＨＡＲＱ個体
５０８・・・ＴＦＣ(TF Combination)選択部
５１０・・・ＥＵＤＣＨ関連上りリンク
５１２・・・ＥＵＤＣＨ
５１４・・・ＥＵＤＣＨ関連下りリンク
５１８・・・ＭＡＣ－ｄ階層
５１６・・・ＭＡＣ制御信号

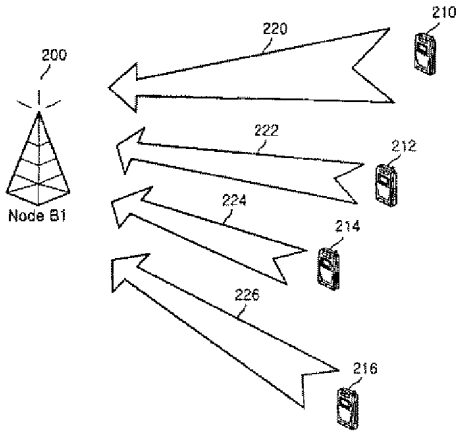
【図1A】



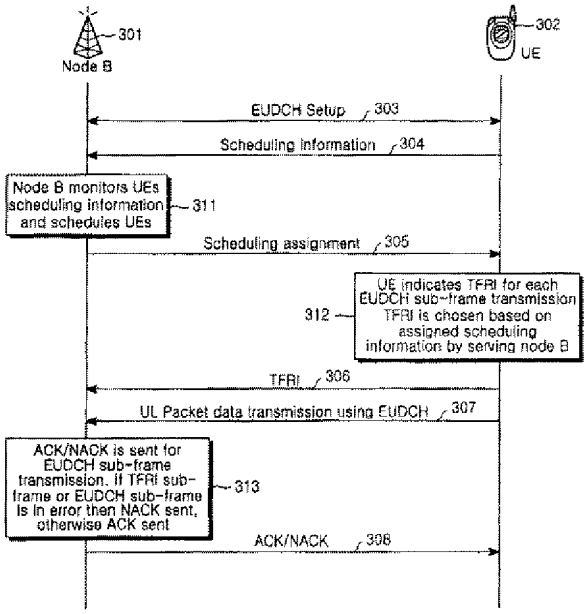

【図1B】



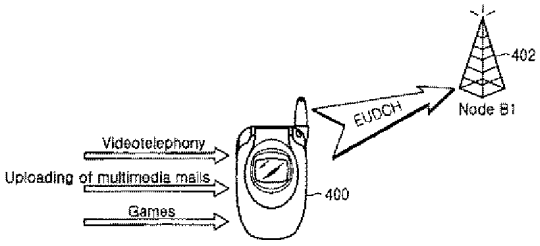

【図2】



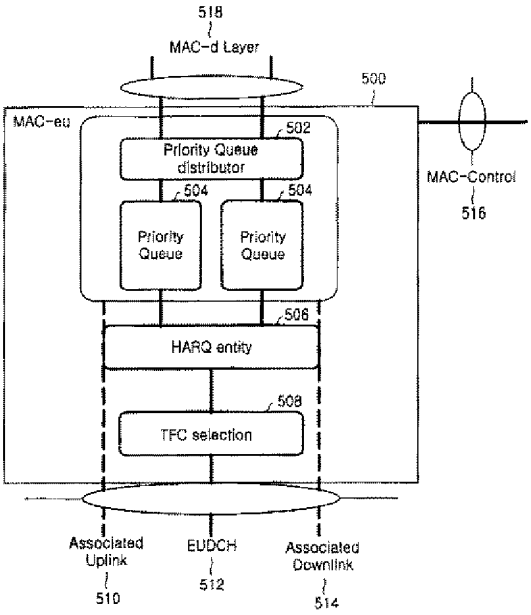

【図3】



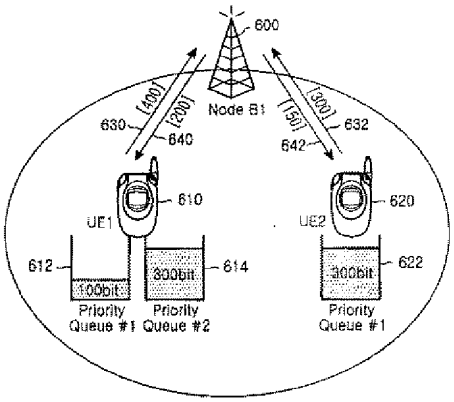

【図4】



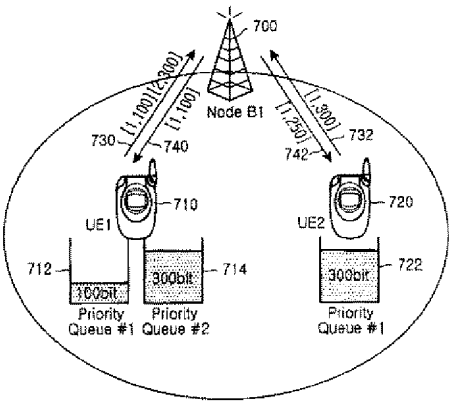
【図5】


518
MAC-d Layer
500
MAC-eu
502
Priority Queue distributor
504
504
Priority Queue
Priority Queue
MAC-Control
516
506
HARQ entity
508
TFC selection
Associated Uplink
510
EUDCH
512
Associated Downlink
514

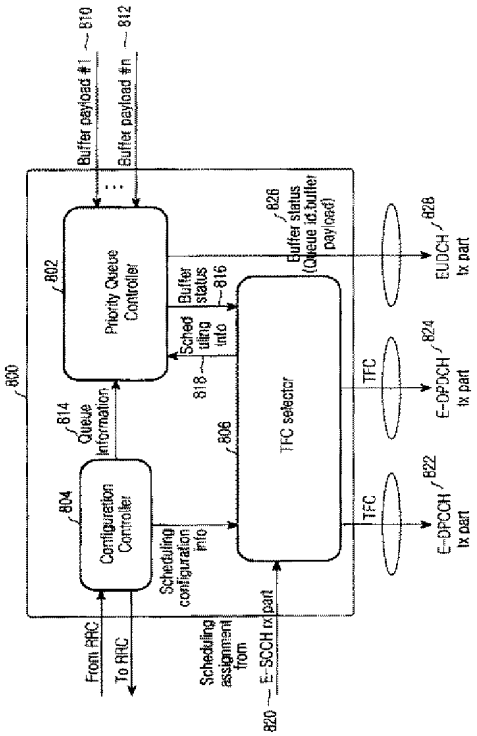
【図6】


600
Node B1
(400)
(200)
630
640
(300)
(150)
632
642
610
UE1
620
UE2
612
100bit
614
300bit
622
300bit
Priority Queue #1
Priority Queue #2
Priority Queue #1

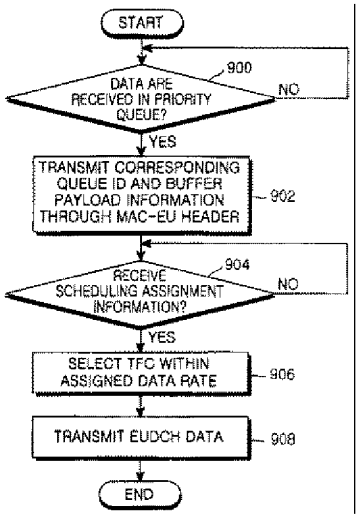
【図7】


700
Node B1
(1,100)
(3,300)
(1,100)
730
740
(1,250)
(1,300)
742
732
710
UE1
720
UE2
712
100bit
714
300bit
722
300bit
Priority Queue #1
Priority Queue #2
Priority Queue #1

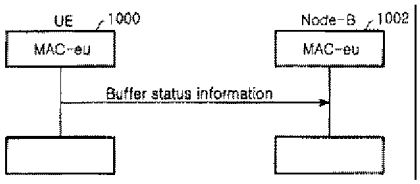
【図8】


800
Buffer payload #1
810
Buffer payload #n
812
802
Priority Queue Controller
826
Buffer status (Queue id,Buffer payload)
EUDCH tx part
828
Buffer status
816
Scheduling info
818
814
Queue information
804
Configuration Controller
806
TFC selector
TFC
E-DPDCH tx part
824
TFC
E-DPCCH tx part
822
Scheduling configuration info
From RRC
To RRC
Scheduling assignment from
820
E-SCCH rx part

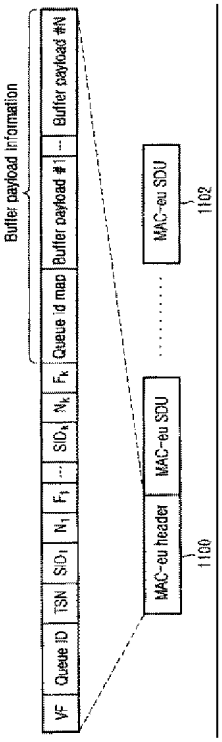
【図9】



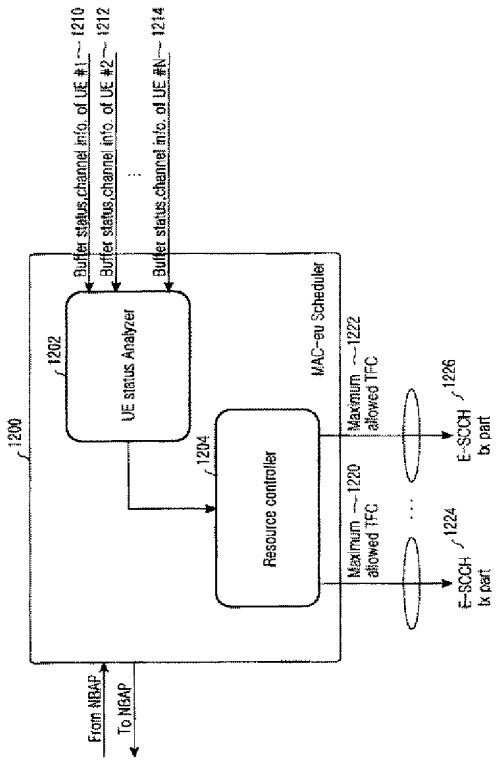

【図10】



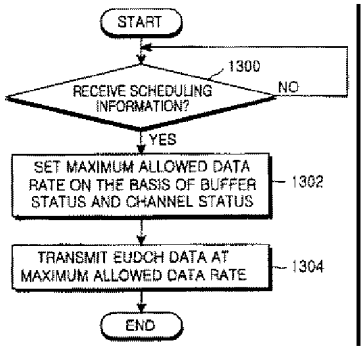

【図11】



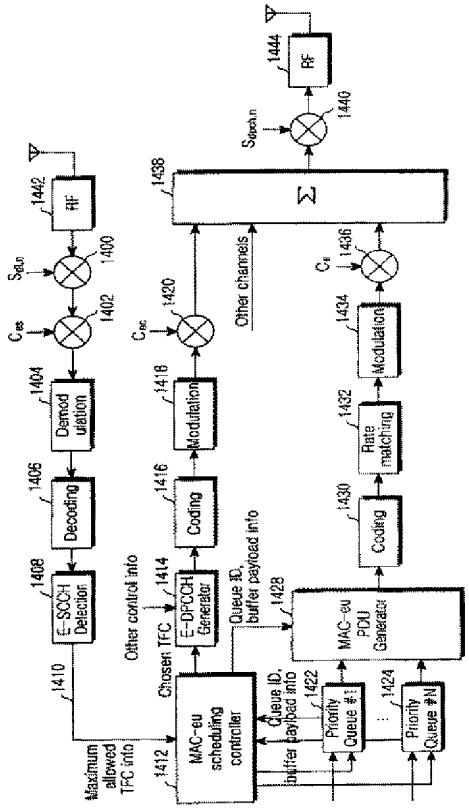

【図12】



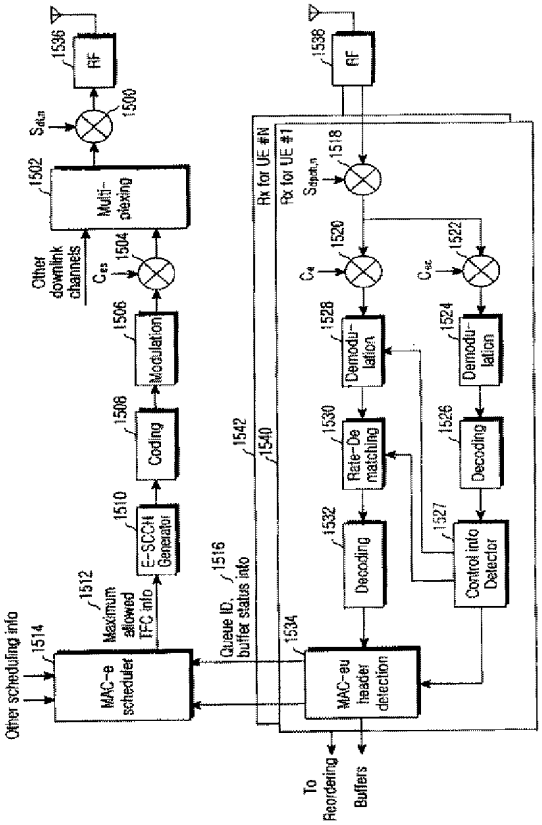

【図13】



【図14】


RF
Demodulation
Decoding
E-SCCH Detection
Maximum allowed TFC info
Other control info
Chosen TFC
E-DPCCH Generator
Coding
Modulation
MAC-eu scheduling controller
Queue ID, buffer payload info
Priority Queue #1
Priority Queue #N
MAC-eu PDU Generator
Rate matching
Modulation
Coding
Other channels
Σ
RF

【図15】


RF
Multi-plexing
Other downlink channels
Coding
Modulation
E-SCCH Generator
Maximum allowed TFC info
Other scheduling info
MAC-e scheduler
Queue ID, buffer status info
Rx for UE #N
Rx for UE #1
Demodulation
Rate-De matching
Decoding
Control info Detector
MAC-eu header detection
To Reordering Buffers
RF

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5K034 AA04 AA17 CC01 DD01 EE03 FF02 FF13 GG05 HH01 HH25
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【要約の続き】

【外国語明細書】

# METHOD AND APPARATUS FOR SCHEDULING ASSIGNMENT OF UPLINK PACKET TRANSMISSION IN MOBILE TELECOMMUNICATION SYSTEM

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a mobile telecommunication system, and more particularly to a method and an apparatus for efficiently transceiving scheduling assignment information for transmitting packet data through an uplink (UL).

2. Description of the Related Art

An asynchronous Wideband Code Division Multiple Access (hereinafter, referred to as a WCDMA) communication system employs an Enhanced Uplink Dedicated Channel (hereinafter, referred to as an EUDCH or E-DCH) in order to support a high speed packet data service through an uplink. The EUDCH is a channel proposed to improve the performance of a packet transmission in an uplink communication in an asynchronous code division multiple access communication system. The EUDCH-related technology includes new technologies for a more reduced Transmission Time Interval (TTI) together with the Adaptive Modulation and Coding (AMC) method and the Hybrid Automatic Retransmission Request (HARQ) method already used in a High Speed Downlink packet access (HSDPA). Further, a Node B control scheduling of an uplink channel is used. The Node B control scheduling for the uplink is very different from a scheduling for a downlink.

Since uplink signals transmitted from a plurality of user equipments (hereinafter, referred to as UEs) do not maintain orthogonality between the

uplink signals, the uplink signals function as interference signals between themselves. Therefore, as the number of uplink signals received in the Node B increase, the number of interference signals for uplink signals transmitted from a specific UE also increases. Accordingly, as the number of the interference signals with respect to the uplink signals transmitted from the specific UE increases, the reception performance of the Node B is reduced. In order to overcome such a problem, uplink transmission power may be increased. However, an uplink signal having increased transmission power also functions as an interference signal with respect to another signal. Accordingly, the Node B limits the number of a receivable uplink signals while ensuring its own reception performance. Equation (1) represents the number of the receivable uplink signal while the reception performance of the Node B is ensured.

$$ROT = \frac{I_o}{N_o} \qquad \cdots\cdots(1)$$

In Equation (1), $I_o$ represents an entire reception wideband power spectral density of the Node B and $N_o$ represents a thermal noise power spectral density of the Node B. Accordingly, the ROT is a radio resource capable of being assigned by the Node B for the EUDCH packet data service in an uplink.

FIGs. 1A and 1B show variations of an uplink radio resource assigned by a Node B. As shown in FIGs. 1A and 1B, the uplink radio resource assigned by the Node B is obtained by the sum of inter-cell interference (hereinafter, referred to as an ICI), voice traffic, and EUDCH packet traffic.

FIG. 1A shows variation of the total ROT when Node B scheduling is not used. Since scheduling is not performed for the EUDCH packet traffic, the total ROT grows larger than a target ROT when a plurality of UEs transmit the packet data at a high data rate at the same time. Herein, the reception performance of the uplink signal is reduced.

FIG. 1B shows variation of the total ROT when Node B scheduling is used, thereby preventing the multiple UEs from transmitting the packet data at a

high data rate at the same time. That is, the Node B scheduling enables a high data rate to be permitted to a specific UE and a low data rate to be permitted to other UEs, thereby preventing the total ROT from exceeding the target ROT. Accordingly, Node B scheduling can always maintain constant reception performance.

The Node B notifies each UE of information regarding whether or not EUDCH data can be transmitted by means of a request data rate of UEs using the EUDCH or channel status information representing transmission quality of an uplink. Also, the Node B adjusts the EUDCH data rate. Further, in order to improve the performance of a mobile communication system, the Node B scheduling assigns the data rate to the UEs so that the total ROT of the Node B does not exceed the target ROT. For example, the Node B may assign a low data rate to a UE in a position remote from the Node B and a high data rate to a UE in a position near to the Node B.

FIG. 2 is a view illustrating a basic concept regarding circumstances in which a Node B scheduling is used in an EUDCH. In FIG. 2, Node B 200 supports the EUDCH and reference numerals 210, 212, 214, and 216 represent UEs transmitting the EUDCH. When a data rate of a certain UE increases, reception power received in the Node B 200 from the UE increases. Accordingly, a ROT of the UE occupies a large portion of the total ROT. In contrast, when a data rate of another UE is reduced, reception power received in the Node B 200 from another UE is reduced. Accordingly, a ROT of another UE occupies a small portion of the total ROT. The Node B 200 performs the Node B scheduling for the EUDCH packet data in consideration of the relation between the data rates and a radio resource requested by the UEs 210, 212, 214, and 216.

In FIG. 2, the UEs 210, 212, 214, and 216 transmit the packet data with different uplink transmission powers from each other according to the distance between the Node B 200 and the UEs 210, 212, 214, and 216. UE 210, in the furthest position from the Node B 200, transmits the packet data with the highest

transmission power 220 of an uplink channel. In contrast, UE 214, in the nearest position to the Node B 200, transmits the packet data with the lowest transmission power 224 of an uplink channel. In order to improve the performance of a mobile communication system while maintaining the total ROT and reducing an ICI for another cell, the Node B performs scheduling so that the transmission power intensity of the uplink channel is inversely proportional to the data rate, thereby assigning a relatively lower data rate to the UE 210 having the highest transmission power of an uplink channel and a relatively higher data rate to the UE 214 having the lowest transmission power of an uplink channel.

FIG. 3 is a flow diagram illustrating a basic transmission/reception procedure between a UE 302 transmitting an EUDCH and a Node B 301 including the UE 302.

In step 303, a setup of an EUDCH is accomplished between the Node B 301 and the UE 302. The setup step includes a transmission step of messages through a dedicated transport channel. When the EUDCH setup is accomplished, the UE 302 informs the Node B 301 of scheduling information at step 304. The scheduling information may include UE transmission power information enabling uplink channel information to be understood, extra information of transmission power capable of being transmitted by a UE, and the amount of data stored in a buffer of a UE that must be transmitted.

In step 311, the Node B 301 monitors the scheduling information of the UE 302 and schedules the UE 302. When the Node B 301 determines to permit an uplink data transmission to the UE 302 in step 311, the Node B 301 transmits scheduling assignment information containing an assigned data rate and a transmission timing to the UE 302 in step 305. In step 312, the UE 302 determines a Transport Format (TF) such as a data rate for a EUDCH transmission based on the scheduling assignment information and chooses a Transport Format Resource Indicator (TFRI) indicating the TF. In step 307, the UE 302 transmits EUDCH data by means of the TFRI. Further, the TFRI, which is related information representing the TF of the EUDCH data, is

transmitted to the Node B 301 in step 306 together with the EUDCH data. In step 313, the Node B 301 determines whether or not an error exists in the TFRI and the EUDCH data. As a result of the determination, when the error exists in at least one of the TFRI and the EUDCH data, the Node B 301 transmits an NACK to the UE 302 through an ACK/NACK channel, in step 308. In contrast, when any error does not exist in the TFRI and the EUDCH data, the Node B 301 transmits an ACK to the UE 302 through an ACK/NACK channel, in step 308.

The Node B 301 decides a data rate to be assigned to a UE on the basis of the scheduling information. Herein, the Node B 301 assigns a proper data rate and transmission timing to multiple UEs using an EUDCH. Further, in the scheduling, the Node B 301 assigns a resource to each UE in order to prevent a ROT value of an uplink from exceeding a target ROT value. Herein, the Node B 301 assigns many resources to a UE having a good channel condition in order to improve the entire performance of a system.

FIG. 4 is a view showing the types of data transmitted from a UE to a Node B for an uplink packet data service.

As shown in FIG. 4, a UE 400 can transmit voice and image traffic, packet data, data regarding a game, etc., to a Node B 402 through an EUDCH. The data transmitted from the UE as described above requires different quality of service (QoS) according to the types of the data. Accordingly, it is necessary to provide a method by which the Node B 402 performs a scheduling and assigns a radio resource according to quality of service required by data to be transmitted from a UE.

## SUMMARY OF THE INVENTION

Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the prior art, and it is an object of the present invention is to provide a method and an apparatus for assigning a radio resource according to quality of service required by data to be transmitted.

It is another object of the present invention is to provide a method and an apparatus for assigning many radio resources with respect to data requesting high quality of service and a few radio resources with respect to data requesting low quality of service.

It is further object of the present invention is to provide a method and an apparatus for efficiently using a radio resource of a mobile communication system by assigning radio resources different from each other according to quality of service.

In order to accomplish the aforementioned objects, according to one aspect of the present invention, there is provided a method for reporting status of a buffer storing packet data to be transmitted by a user equipment for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method including storing packet data having a priority corresponding to a plurality of priority queues having inherent priorities and relating to at least one service; and transmitting buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues.

In order to accomplish the aforementioned objects, according to another aspect of the present invention, there is provided a method which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method including generating a protocol data unit including a header part and a payload part for the uplink packet data service; and inserting the scheduling information into the header part, inserting packet data for the uplink packet data service into the payload part, and transmitting the protocol data unit.

In order to accomplish the aforementioned objects, according to a further aspect of the present invention, there is provided an apparatus for reporting status of a buffer storing packet data to be transmitted by a user equipment for a

scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus including a plurality of priority queues having same priorities, for storing packet data relating to at least one service; a scheduling controller for generating buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues; and a transmission unit for transmitting the buffer status information.

In order to accomplish the aforementioned objects, according to still another aspect of the present invention, there is provided an apparatus which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus including a plurality of priority queues having same priorities, for storing packet data relating to at least one service; and a protocol data unit generator for generating a protocol data unit containing a header part and a payload part for the uplink packet data service, receiving packet data outputted from the priority queues, inserting the scheduling information into the header part, inserting packet data into the payload part, and transmitting the protocol data unit.

In order to accomplish the aforementioned objects, according to yet a further aspect of the present, there is provided a Node B for scheduling an uplink packet data service from a user equipment in a mobile communication system, the Node B including a reception unit for a protocol data unit containing a header part and a payload part for the uplink packet data service; a header detection unit for detecting scheduling information for the uplink packet data service from the header part of the protocol data unit and detecting packet data from the payload part of the protocol data unit; a scheduler for generating scheduling assignment information for the uplink packet data service according to the scheduling information; and a transmission unit for transmitting the scheduling assignment information to the user equipment.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1A is a view showing variations of an uplink radio resource of a Node B when a Node B control scheduling is not used;

FIG. 1B is a view showing variations of an uplink radio resource of a Node B when a Node B control scheduling is used;

FIG. 2 is a view illustrating a UE and a Node B performing uplink packet transmission;

FIG. 3 is a view showing information exchanged between a UE and a Node B in order to perform uplink packet transmission;

FIG. 4 is a view showing the types of data transmitted from a UE to a Node B for an uplink packet data service;

FIG. 5 is a view showing a structure of a logical layer of a UE according to a preferred embodiment of the present invention;

FIG. 6 is a view illustrating transmission/reception of scheduling assignment information between a UE and a Node B according to one embodiment of the present invention;

FIG. 7 is a view illustrating transmission/reception of scheduling assignment information between a UE and a Node B according to another embodiment of the present invention;

FIG. 8 is a view showing a structure of a logical layer of a UE according to a preferred embodiment of the present invention;

FIG. 9 is a flowchart illustrating an operation performed in a structure of a logical layer of a UE according to a preferred embodiment of the present invention;

FIG. 10 is a view illustrating an operation by which buffer status

information is transmitted from a logical layer of a UE to a logical layer of a Node B according to a preferred embodiment of the present invention;

FIG. 11 is a view showing a structure of an EUDCH transmitting a buffer status information of a UE according to a preferred embodiment of the present invention;

FIG. 12 is a view showing a structure of a logical layer of a Node B according to a preferred embodiment of the present invention;

FIG. 13 is a flowchart showing an operation performed in a structure of a logical layer of a Node B according to a preferred embodiment of the present invention;

FIG. 14 is a block diagram illustrating a transmission/reception operation performed by a UE according to a preferred embodiment of the present invention; and

FIG. 15 is a block diagram illustrating a transmission/reception operation performed by a Node B according to a preferred embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, a preferred embodiment according to the present invention will be described with reference to the accompanying drawings. In the following description of the present invention, a detailed description of known functions and configurations incorporated herein will be omitted when it may make the subject matter of the present invention unclear.

A Universal Mobile Telecommunication Service (hereinafter, referred to as a UMTS), one of the 3rd Generation Partnership Project (3GPP) mobile communication services, is based on a communication standard of a Global System for Mobile Communication (hereinafter, referred to as a GSM) and a General Packet Radio Service (GPRS) employs a wideband CDMA technology, in contrast to the GSM employing a Time Division Multiple Access (TDMA).

A UMTS Terrestrial Radio Access Network (hereinafter, referred to as a UTRAN) includes Node Bs containing a plurality of cells and a Radio Network Controller (hereinafter, referred to as a RNC) managing radio resources of the Node Bs.

An interface between a UE and a RNC is called an Uu interface and is classified as a control plane for exchanging control and signaling signals and a user plane for transmitting data traffic. The control plane includes a radio resource control (RRC) layer, a radio link control (RLC) layer, a media access control (MAC) layer, and a physical (hereinafter, referred to as a PHY) layer. Further, the user plane includes a packet data control protocol (PDCP) layer, an RLC layer, a MAC layer, and a PHY layer. Herein, the PHY layer is located in each cell and the layers between a MAC layer and a RRC layer are located in a RNC.

Particularly, a portion related to a user plane in a MAC layer is called a MAC-d and a portion related to a control plane is called a MAC-c. User data to be transmitted through a dedicated transport channel is generated into a transmission block having a desired size through a MAC-d layer. When the user data is transmitted through an EUDCH, the transmission block passes through a MAC-eu portion in the MAC layer. A MAC-eu layer performs a process a Node B control scheduling, HARQ, etc., for an EUDCH before transmitting data sent from a MAC-d layer to a PHY layer.

FIG. 5 is a view showing a structure of a MAC-eu layer of a UE transmitting an EUDCH according to a preferred embodiment of the present invention.

The MAC-eu layer 500 of the UE includes a priority queue distributor 502 and a priority queues (PQs) 504, and receives data to be transmitted to a Node B from a MAC-d layer 518. The received data is sent to the priority queue distributor 502 of the MAC-eu layer 500. The priority queue distributor 502 determines a priority for the received data and buffers the data in a priority queue, which corresponds to the determined priority, from among the priority

queues 504.

The priority queues 504 are used in storing data according to a priority of a service to be provided and have inherent queue identifiers (hereinafter, referred to as QIDs) respectively. That is, each of the priority queues 504 is related to at least one service and stores data having different priorities. FIG. 5 shows two priority queues 504, but the number of the priority queues 504 is randomly determined by a MAC control signal 516 according to the type and number of services being provided. That is, when a priority for data to be transmitted to the Node B is classified as multiple steps, the number of the priority queues 504 increases. The priority is determined according to a transmission time point (i.e., required delay) at which data is to be transmitted to the Node B. That is, data which must be transmitted to the Node B within a rapid time period has a high priority, and data which does not have the necessity of being transmitted to the Node B within a rapid time period has a low priority.

The priority queue distributor 502 determines a priority for the received data and sends the data to one of the priority queues 504 according to the determined priority. In this way, data having the same priority is sent to the same priority queue. The priority queues 504 store the received data before a resource is assigned by the scheduling of the Node B.

In order to request a scheduling assignment from the Node B, the MAC-eu layer 500 transmits scheduling information, which contain a buffer status representing the amount of the data stored in the priority queues 504 and a channel status representing the transmission quality of an uplink, through an EUDCH related uplink 510. When the Node B transmits scheduling assignment information to the UE through an EUDCH related downlink 514, a Transport format combination (hereinafter, referred to as a TFC) selection part 508 determines a TFC by means of the scheduling assignment information, reads the data from the priority queues 504 by means of the determined TFC, and transmits the read data through an EUDCH 512. Herein, the UE first transmits data having a high priority stored in the priority queues 504. Therefore, a

transmission time can be differently designated according to the priority. Meanwhile, an HARQ entity 506 interprets an ACK/NACK received through the related downlink 514 with respect to the transmitted data, discards data stored in a corresponding priority queue when an ACK is received, and retransmits data stored in a corresponding priority queue when an NACK is received.

FIG. 6 is a view illustrating an operation by which two UEs request a scheduling assignment to a Node B according to one embodiment of the present invention.

In FIG. 6, the UE 610 includes two priority queues 612 and 614 and the UE 620 includes one priority queue 622. The priority queue 612 of the UE 610 has a priority higher than that of the priority queue 614, and the priority queue 622 of the UE 620 has the same priority as that of the priority queue 612 of the UE 610. The priority queue 612 of the UE 610 stores 100 bits of data, the priority queue 614 of the UE 610 stores 300 bits of data, and the priority queue 622 of the UE 620 stores 300 bits of data. The Node B 600 has a radio resource capable of receiving only 450 bits of data.

Referring to FIG. 6, the UEs 610 and 620 transmit buffer status information 630 and 632 representing the amount of data to be transmitted to the Node B 600. That is, the UE 610 transmits the buffer status information 630 corresponding to 400 bits to the Node B 600, and the UE 620 transmits the buffer status information 632 corresponding to 300 bits to the Node B 600. Herein, when uplink channel conditions of the UEs 610 and 620 are identical to each other, the Node B 600 transmits scheduling assignment information 640, which enables only 200 bits to be transmitted, to the UE 610, and scheduling assignment information 642, which enables only 150 bits to be transmitted, to the UE 620.

The UE 610 determines a TFC by means of the scheduling assignment information 640, transmits data through an EUDCH by means of the determined TFC. That is, according to a priority, 100 bits of data on standby in the priority queue 612 are first transmitted, and then 100 bits of data on standby in the

priority queue 614 are transmitted. The UE 620 also determines a TFC by means of the scheduling assignment information 642, transmits data through an EUDCH by means of the determined TFC. That is, 150 bits of data on standby in the priority queue 622 are transmitted.

Herein, although the priority queue 612 of the UE 620 has a priority higher than that of the priority queue 614 of the UE 610, all data in the standby state are not transmitted. That is, when there exists one UE requesting the scheduling assignment information to the Node B 600, data in the standby state are transmitted according to priority. However, when there exists two or more UEs requesting the scheduling assignment information to the Node B 600, there occurs a problem in that data having a higher priority are transmitted later than data having a low priority.

FIG. 7 is a view illustrating a preferred embodiment of the present invention for solving the problem in FIG. 6. In FIG. 7, UEs 710 and 720 transmit not only the amount of data but also information on a priority to a Node B 700 at the same time.

Referring to FIG. 7, the UE 710 includes two priority queues 712 and 714 and the UE 720 includes one priority queue 722. The priority queue 712 of the UE 710 has a priority higher than that of the priority queue 714, and the priority queue 722 of the UE 720 has the same priority as that of the priority queue 712 of the UE 710. The priority queue 712 of the UE 710 stores 100 bits of data, the priority queue 714 of the UE 710 stores 300 bits of data, and the priority queue 722 of the UE 720 stores 300 bits of data.

The UEs 710 and 720 transmit buffer status information 730 and 732 containing the amount of data to be transmitted and information on a priority to the Node B 700. That is, the UE 710 transmits the buffer status information 730 containing the amount of data corresponding to 400 bits and a QID representing a priority to the Node B 700. That is, the buffer status information 730 signifies that the amount of data corresponding to a Priority 1 is 100 bits and the amount of data corresponding to a Priority 2 is 300 bits. Further, the UE 720 transmit

the buffer status information 732 containing the amount of data corresponding to 300 bits and a QID representing a priority to the Node B 700. Herein, when uplink channel conditions of the UEs 710 and 720 are identical to each other, the Node B 700 transmits scheduling assignment information 740 and 742 to the UEs 710 and 720 in consideration of the priority. That is, the Node B 700 transmits scheduling assignment information 740, which enables only 100 bits to be transmitted, to the UE 710, and scheduling assignment information 742, which enables only 250 bits to be transmitted, to the UE 720.

The UE 710 determines a TFC by means of the scheduling assignment information 740, transmits data through an EUDCH by means of the determined TFC. That is, 100 bits of data on standby in the priority queue 712 are transmitted according to priority. The UE 720 also determines a TFC by means of the scheduling assignment information 742, transmits data through an EUDCH by means of the determined TFC. That is, 250 bits of data on standby in the priority queue 722 are transmitted. In this way, the UEs 710 and 720 can first transmit data having a high priority.

FIG. 8 is a view showing a structure of a MAC-eu scheduling controller of a UE according to a preferred embodiment of the present invention.

Referring to FIG. 8, the scheduling controller 800 includes a configuration controller 804, a priority queue (PQ) controller 802, and a TFC selector 806. The priority queue controller 802 receives buffer payload information 810 and 812 from priority queues, and the buffer payload information 810 and 812 represent the amount of data on standby in each priority queue. In FIG. 8, it is assumed that N number of priority queues exist. The buffer payload information 810 represents buffer payload information sent from a priority queue 1 and the buffer payload information 812 represents buffer payload information sent from a priority queue n. Further, the priority queue controller 802 receives queue information 814 from the configuration controller 804. Herein, the queue information 814 is configuration information of priority queues, and it is related to the sizes and the number of memories of priority

queues.

The priority queue controller 802 transmits a buffer status information 826 containing a QID regarding a priority of a corresponding buffer payload information 810 and 812 to the Node B through an EUDCH tx part 828.

The TFC selector 806 receives scheduling assignment information 820 through a shared control channel for EUDCH (E-SCCH), a buffer status information 816 about priority queues from the priority queue controller 802, and scheduling configuration information from the configuration controller 804. The scheduling configuration information contains priorities of priority queues, transport format combination set, etc. The TFC selector 806 determines a TFC by means of the buffer status information 816 and the scheduling assignment information 820. The TFC is determined so that data stored in a priority queue having a high priority is first transmitted.

The TFC selector 806 transmits the determined TFC to a dedicated physical data channel for EUDCH (hereinafter, referred to as a E-DPDCH) tx part 824. The E-DPDCH tx part 824 transmits EUDCH packet data by means of the received TFC. Herein, the determined TFC is transmitted to a dedicated physical control channel for EUDCH (hereinafter, referred to as a E-DPCCH) tx part 822. The E-DPCCH tx part 822 transmits control information containing the TFC together with the EUDCH packet data at the same time point. Also, the TFC is transmitted to the priority queue controller 802 over a scheduling information 818. The priority queue controller 802 understands by means of the TFC the priority queue in which transmitted data has been in a standby state by means of the TFC, and renews the buffer status of the priority queues.

FIG. 9 is a flowchart illustrating an operation of a MAC-eu scheduling controller according to a preferred embodiment of the present invention.

Referring to FIG. 9, in step 900, the scheduling controller determines whether or not new data has arrived at priority queues by buffer payload information sent from priority queues. Further, the scheduling controller determines a priority queue from which the buffer payload information has been

transmitted, thereby understanding the amount and priority of data transmitted to the priority queues. When the new data has arrived at the priority queues, step 902 is performed. In contrast, when the new data has not arrived at the priority queues, the process returns to step 900.

In step 902, the scheduling controller transmits buffer status information containing the buffer payload information and buffer status information containing a QID representing a priority relating to the buffer payload information to a Node B.

In step 904, the scheduling controller determines whether or not scheduling assignment information is received from the Node B. The scheduling assignment information contains information on a maximum data rate capable of being used by a UE and a permission timing. From the result of the determination, when the scheduling assignment information has been received from the Node B, step 906 is performed. In contrast, when the scheduling assignment information has not been received from the Node B, the process returns to step 904.

In step 906, the scheduling controller determines a TFC within a data rate assigned by the scheduling assignment information. In determining the TFC, the scheduling controller enables data having a high priority to be first transmitted in consideration of the priority of the data transmitted to the priority queues. In step 908, the scheduling controller controls the data transmitted to the priority queues to be transmitted by means of the determined TFC. The MAC-eu layer generates a MAC-eu protocol data unit (PDU) containing data read from a corresponding priority queue by the control command of the scheduling controller, and transmits the generated MAC-eu PDU through the E-DPDCH. Further, the scheduling controller transmits the determined TFC through the E-DPCCH, and renews information on the changed buffer status. The renewed buffer status is transmitted through an EUDCH.

FIG. 10 is a view illustrating a MAC-eu signaling between a UE and a Node B according to a preferred embodiment of the present invention. As

shown in FIG. 10, the MAC-eu layer 1000 of the UE transmits a buffer status message to the MAC-eu layer 1002 of the Node B. The buffer status information contains a QID and a buffer payload of a priority queue as described above.

FIG. 11 is a view showing a construction of a MAC-eu PDU containing buffer status information according to a preferred embodiment of the present invention. As shown in FIG. 11, the MAC-eu PDU includes a MAC-eu header 1100 contained in a header part and a plurality of MAC-eu service data units 1102 (SDUs) contained in a payload part. Information contained in the MAC-eu header 1100 is as follows:

A version flag (VF) representing the version of a MAC-eu PDU format.

A QID identifying of a priority queue from which a MAC-eu SDU is outputted, constructed of 3 bits.

A transmission sequence number (TSN) for realigning a MAC-eu SDU according to a priority, constructed of 5 to 6 bits.

An SID_k representing the size of MAC-d SDUs belonging to an $x^{th}$ MAC-eu SDU set from among the sets of the MAC-d SDUs constituting a MAC-eu PDU, constructed of 2 to 3 bits.

An N_k representing the number of MAC-d PDUs belonging to a MAC-eu SDU set, constructed of 7 bits.

A flag (F). When flag (F) is set to 1, the next field is a MAC-eu PDU. When F (flag) is set to 0, the next field is an SID.

A QID map representing an identifier of a priority queue in which data exists, and a bit number is assigned for as many as the number of priority queues. A numeral 1 represents existence of data and a numeral 0 represents absence of data.

A buffer payload represents the size of data stored in priority queues in which the value of the QID map is 1, and a bit number according to the length of the QID map is assigned.

FIG. 12 is a view showing a structure of a MAC-eu scheduler of a Node

B according to a preferred embodiment of the present invention.

Referring to FIG. 12, the scheduler 1200 includes a UE status analyzer 1202 and a resource controller 1204. The UE status analyzer 1202 receives buffer status messages and channel status messages 1210, 1212, and 1214 of UEs UE#1 to UE#N located in a cell area managed by the Node B. The UE status analyzer 1202 receives buffer status information according to a priority queue contained in a MAC-eu header of a MAC-eu PDU transmitted from each UE and estimates the amount of data stored in a priority queue of each UE. Further, the UE status analyzer 1202 transmits an estimated value for the amount of data in each UE to the resource controller 1204.

The resource controller 1204 calculates an ROT to be assigned to a specific UE in consideration of the estimated value for the amount of data in each UE, the channel status, and a target ROT provided from an RNC through a Node B application protocol (NBAP), and determines a maximum allowed data rate to be assigned to the UE in consideration of the priorities of the priority queues of the UE. Further, when the TFC is determined, the size of data which can be transmitted from the UE and an offset of transmission power are determined according to the TFC. The maximum allowed data rate to be assigned to the UE is contained in maximum allowed TFC information 1220 and 1222 and then transmitted to the UE by E-SCCH tx parts 1224 and 1226.

FIG. 13 is a flowchart showing an operation of a MAC-eu scheduler of a Node B according to a preferred embodiment of the present invention.

Referring to FIG. 13, in step 1300, the scheduler determines whether or not a MAC-eu PDU containing scheduling information has been received from a UE. The scheduling information contains buffer payload information of each UE and information on a priority of each buffer. From the result of the determination, when the scheduling information has been received, step 1302 is performed. In contrast, when the scheduling information has not been received, the process returns to step 1300.

In step 1302, the scheduler determines a maximum allowed data rate to

be assigned to the UE on the basis of the buffer status information and the channel status information received from the UE. The maximum allowed data rate is determined in consideration of the target ROT provided from the RNC and a priority of data to be transmitted by the UE. Further, the maximum allowed data rate is transmitted to the UE through a control channel relating to an EUDCH in step 1304.

FIG. 14 is a block diagram illustrating an apparatus for performing a transmission/reception operation by a UE according to a preferred embodiment of the present invention. First, an operation of a reception side receiving scheduling assignment information will be described.

Referring to FIG. 14, a signal received in an antenna passes through a radio frequency (RF) unit 1442, is converted into a baseband signal, and then is inputted to a descrambler 1400. The descrambler 1400 descrambles the baseband signal by a scrambling code $S_{dl,n}$. The descrambled signal is sent to a despreader 1402. In order to perform dechannelization for the descrambled signal, the despreader 1402 multiplies the descrambled signal by a channelization code $C_{es}$, and sends the dechannelized signal to a demodulation unit 1404. The dechannelized signal is demodulated by the demodulation unit 1404 and decoded by a decoding unit 1406. Then, an E-SCCH detection unit 1408 detects the scheduling assignment information from the decoded signal, and the scheduling assignment information contains maximum allowed TFC information 1410 assigned to the UE.

The maximum allowed TFC information 1410 is transmitted to a MAC-eu scheduling controller 1412 and the MAC-eu scheduling controller 1412 determines a TFC by means of the maximum allowed TFC information 1410. The TFC is determined considering information on a priority of data on standby in priority queues 1422 and 1424. For this reason, the priority queues 1422 and 1424 store data relating to one or more services having different priorities, and transmit a QID and buffer payload information to the MAC-eu scheduling controller 1412 periodically or whenever new data is stored. The MAC-eu

scheduling controller 1412 transmits information on the determined TFC to an E-DPCCH generator 1414. The E-DPCCH generator 1414 generates a control signal containing other control information and the TFC. The generated control signal is coded by a coding unit 1416 and the coded signal is modulated by a modulation unit 1418. Then, the modulated signal is subjected to channelization by a spreader 1420 with a channelization code Cec and then is transmitted to a multiplexer 1438.

A MAC-eu PDU generator 1428 performs two functions. First, the MAC-eu PDU generator 1428 includes the QID and the buffer status information sent from the MAC-eu scheduling controller 1412 into a MAC-eu header. Secondly, the MAC-eu PDU generator 1428 appends the MAC-eu header to the data on standby in the priority queues 1422 and 1424 by means of the TFC sent from the MAC-eu scheduling controller 1412, and generates a MAC-eu PDU. The MAC-eu PDU is coded by a coding unit 1430 and rate-matched by a rate matching unit 1432. The rate-matched signal is modulated by a modulation unit 1434 and the modulated signal is subjected to channelization by a spreader 1436 with a channelization code $C_e$. The channel coded data is transmitted to multiplexer 1438. The multiplexer 1438 multiplexes signals provided from the spreaders 1420 and 1436 and signals from other channels. The multiplexed signal is scrambled by a scrambler 1440 with a scrambling code $S_{dpch,n}$ and is converted into an RF signal by an RF unit 1444. Then, the RF signal is transmitted to the Node B through an antenna.

FIG. 15 is a block diagram illustrating an apparatus for performing a transmission/reception operation by a Node B according to a preferred embodiment of the present invention. First, an operation of a reception side receiving scheduling information will be described. The reception part of the Node B has N number of reception paths 1540 and 1542 corresponding to each of N number of UEs performing an uplink packet data service. Herein, an operation of the reception path 1540 corresponding to a UE#1 will be described, but it is apparent to those who skilled in the art that the other reception paths also

perform the same operations.

Referring to FIG. 15, a signal received in an antenna passes through an RF unit 1538, is converted into a baseband signal, and then is inputted to a descrambler 1518. The descrambler 1518 descrambles the baseband signal by a scrambling code $S_{dpch,n}$. The descrambled signal is sent to despreaders 1520 and 1522 and then is dechannelized into an E-DPCCH signal and an E-DPDCH signal. The E-DPCCH signal for which channelization has been performed by the despreader 1522 with a channelization code $C_{ec}$ is demodulated by a demodulation unit 1524, and then is decoded by a decoding unit 1526. A control information detector 1527 detects control information necessary in receiving EUDCH data from data decoded by the decoding unit 1526, and the control information contains modulation information, etc., of the EUDCH data.

The E-DPDCH signal for which channelization has been performed by the despreader 1520 with a channelization code $C_e$ is demodulated by a demodulation unit 1528 with the modulation information detected by the control information detection unit 1527. The demodulated signal is subjected to a rate-dematching by a rate-dematching unit 1530 and then is decoded by a decoding unit 1532.

A MAC-eu header detection unit 1534 separates buffer status information in a header and data in a payload from a MAC-eu PDU sent from the decoding unit 1532. Herein, when a QID map in a MAC-eu header has values other than 0, the MAC-eu header detection unit 1534 detects buffer status information 1516 contained in the MAC-eu header to transmit the detected buffer status information 1516 to a MAC-eu scheduler 1514. Herein, the buffer status information 1516 includes at least one QID and buffer payload information. Further, the MAC-eu header detection unit 1534 separates MAC-eu SDUs, except for the MAC-eu header, from the MAC-eu PDU and transmits the MAC-eu SDUs to reordering buffers of an upper layer. The reordering buffers are located in an RNC, correspond to priority queues of a UE-side, and align received MAC-eu SDUs according to TSNs of the MAC-eu SDUs.

The MAC-eu scheduler 1514 generates a maximum allowed TFC information 1512 for each UE by means of the buffer status information 1516 and other scheduling information, and transmits the generated maximum allowed TFC information 1512 to an E-SCCH generator 1510. The maximum allowed TFC is determined considering a priority of data contained the buffer status informaiton to be transmitted. The E-SCCH generator 1510 generates scheduling assignment information for the maximum allowed TFC information 1512. The scheduling assignment information is coded by a coding unit 1508 and then is modulated by a modulation unit 1506. The signal modulated by the modulation unit 1506 is subjected to channelization by a spreader 1504 with a channelization code $C_{es}$, and then is transmitted to a multiplexer 1502. The multiplexer 1502 multiplexes the received signal together with other downlink channel signals. The multiplexed signal is scrambled by a scrambler 1500 with a scrambling code $S_{dl,n}$ and is converted into an RF signal by an RF unit 1536. Then, the RF signal is transmitted to a UE through an antenna.

As described above, in the present invention, when a UE transmits data having required different priorities through an enhanced uplink channel at the same time, a Node B control scheduling reflects the priorities of the data. For this, the UE transmits buffer status information of a priority queue corresponding to quality of service, and a Node B can perform scheduling by means of the received buffer status information of the priority queue. Accordingly, the present invention provides a differentiated service according to required priorities, thereby satisfying the requirements of users.

While the invention has been shown and described with reference to certain preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

1. A method for reporting a status of a buffer storing packet data to be transmitted by a user equipment (UE) for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method comprising the steps of:

a) storing packet data having a priority corresponding to a plurality of priority queues relating to at least one service; and

b) transmitting buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues.

2. The method as claimed in claim 1, wherein, in step b), the buffer status information is inserted into a header part of a protocol data unit (PDU) for the uplink packet data service and the packet data is inserted into a payload part of the protocol data unit, and then the protocol data unit is transmitted.

3. The method as claimed in claim 2, wherein the buffer status information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

4. The method as claimed in claim 2, wherein the header part is a media access control (MAC) signaling header for an enhanced uplink dedicated channel (EUDCH).

5. The method as claimed in claim 1, further comprising a step of receiving scheduling assignment information corresponding to the buffer status from a Node B providing the service to the user equipment, first reading packet data having a high priority from the priority queues according to the scheduling assignment information, and transmitting the read packet data.

6. A method which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method comprising the steps of:

generating a protocol data unit including a header part and a payload part for the uplink packet data service; and

inserting the scheduling information into the header part, inserting packet data for the uplink packet data service into the payload part, and transmitting the protocol data unit.

7. The method as claimed in claim 6, wherein the scheduling information contains queue identifiers representing a plurality of priority queues having inherent priorities and relating to at least one service, and buffer payload information representing an amount of packet data stored in the priority queues.

8. The method as claimed in claim 7, wherein the buffer payload information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

9. The method as claimed in claim 6, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

10. The method as claimed in claim 7, further comprising a step of receiving scheduling assignment information corresponding to the scheduling information from a Node B providing the service to the user equipment, and first transmitting packet data having a high priority according to the scheduling assignment information.

11. An apparatus for reporting a status of a buffer storing packet data to be transmitted by a user equipment for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus comprising:

a plurality of priority queues having same priorities, for storing packet data relating to at least one service;

a scheduling controller for generating buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues; and

transmission unit for transmitting the buffer status information.

12. The apparatus as claimed in claim 11, wherein the transmission unit comprises a protocol data unit generator for generating a protocol data unit containing a header part and a payload part for the uplink packet data service, inserting the buffer status information into the header part, and inserting packet data read from the priority queues into the payload part.

13. The apparatus as claimed in claim 12, wherein the buffer status information includes:

a queue identifier map representing at least one priority queue, in which

the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

14. The apparatus as claimed in claim 12, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

15. The apparatus as claimed in claim 11, wherein the scheduling controller receives scheduling assignment information corresponding to the buffer status from a Node B providing the service to the user equipment, and controls the priority queues to first output packet data having a high priority according to the scheduling assignment information.

16. An apparatus which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus comprising:

a plurality of priority queues having same priorities, for storing packet data relating to at least one service; and

a protocol data unit generator for generating a protocol data unit containing a header part and a payload part for the uplink packet data service, receiving packet data outputted from the priority queues, inserting the scheduling information into the header part, inserting packet data into the payload part, and transmitting the protocol data unit.

17. The apparatus as claimed in claim 16, wherein the scheduling information contains queue identifiers representing the priority queues having inherent priorities and relating to at least one service, and buffer payload

information representing an amount of packet data stored in the priority queues.

18. The apparatus as claimed in claim 17, wherein the scheduling information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

19. The apparatus as claimed in claim 16, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

20. The apparatus as claimed in claim 17, further comprising a scheduling controller for receiving scheduling assignment information corresponding to the scheduling information from a Node B providing the service to the user equipment, and controlling the priority queues to first output packet data having a high priority according to the scheduling assignment information.

21. A Node B apparatus for scheduling an uplink packet data service from a user equipment in a mobile communication system, the Node B comprising:

a reception unit for a protocol data unit containing a header part and a payload part for the uplink packet data service;

a header detection unit for detecting scheduling information for the uplink packet data service from the header part of the protocol data unit and detecting packet data from the payload part of the protocol data unit;

a scheduler for generating scheduling assignment information for the uplink packet data service according to the scheduling information; and

a transmission unit for transmitting the scheduling assignment information to the user equipment.

22. The Node B apparatus as claimed in claim 21, wherein the scheduling information contains queue identifiers representing the priority queues having inherent priorities and relating to at least one service, and buffer payload information representing an amount of packet data stored in the priority queues.

23. The Node B apparatus as claimed in claim 22, wherein the payload information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

24. The Node B apparatus as claimed in claim 21, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

## 1 . ABSTRACT

A method and an apparatus for reporting a buffer status of a buffer storing packet data to be transmitted by a user equipment for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service are disclosed. A user equipment stores packet data having a priority corresponding to a plurality of priority queues having inherent priorities and relating to at least one service, and transmits buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues. Herein, the user equipment inserts the buffer status information into a header part of a protocol data unit for the uplink packet data service, inserts the packet data into a payload part of the protocol data unit, and then transmits the protocol data unit.

## 2 . Representative Drawing

**Fig. 5**

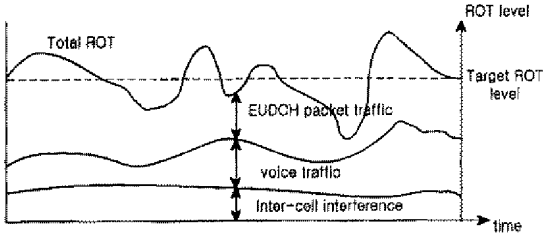


FIG.1A

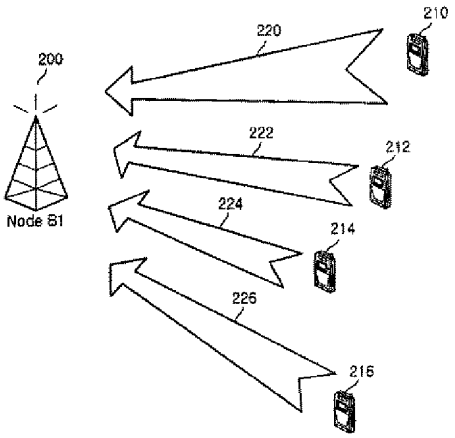


FIG.2

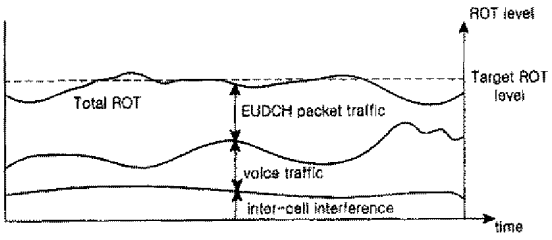


FIG.1B

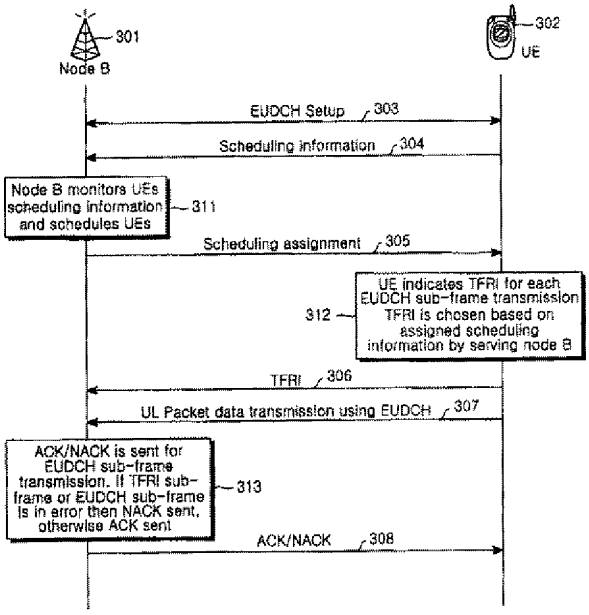


FIG.3

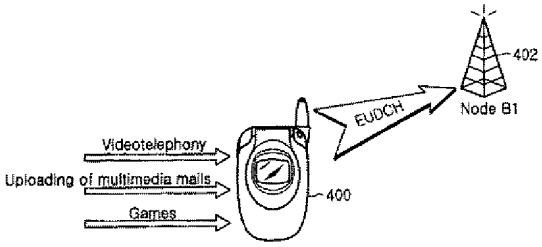


FIG.4

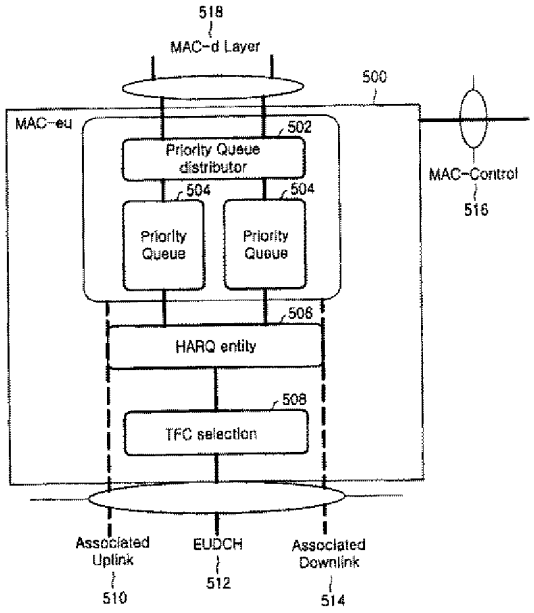


FIG.5

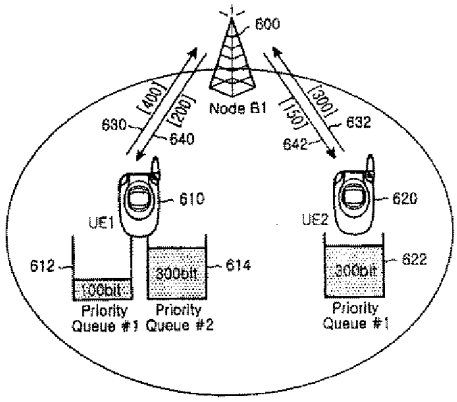


FIG.6

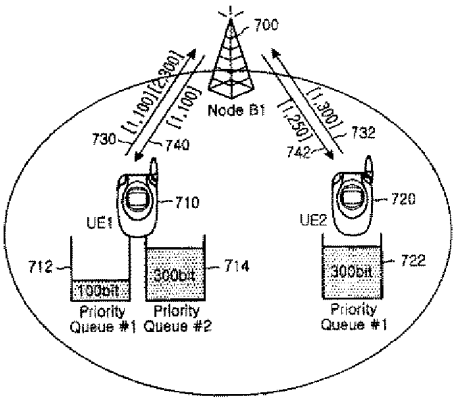


FIG.7

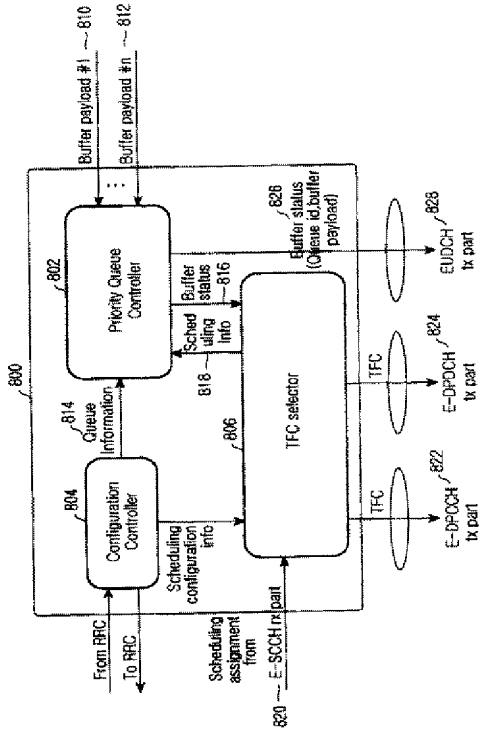


FIG.8

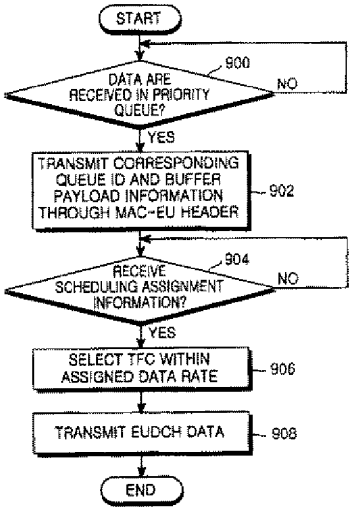


FIG.9

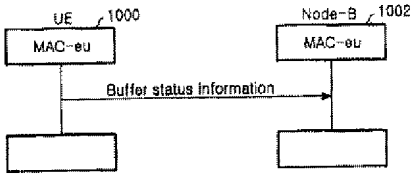


FIG.10

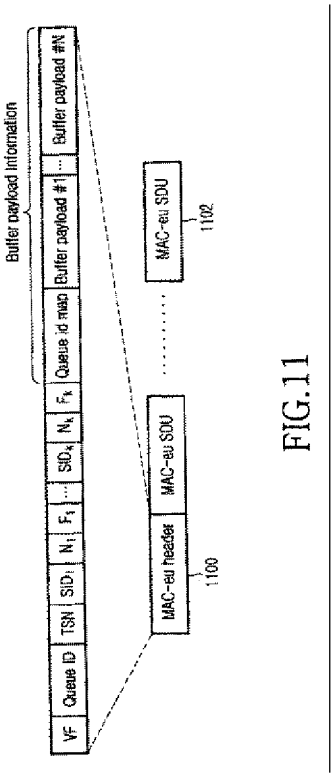


FIG.11

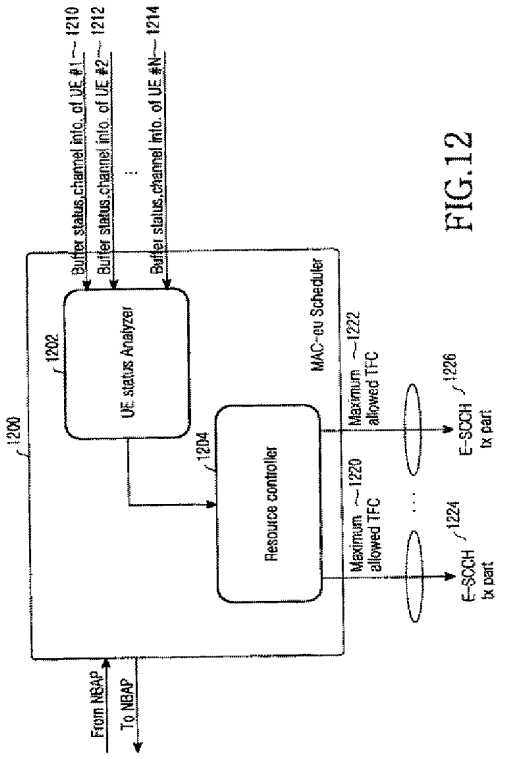


FIG.12

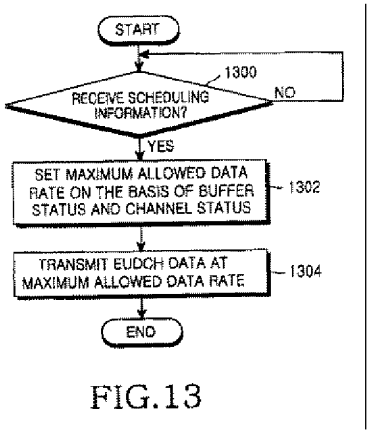


FIG.13

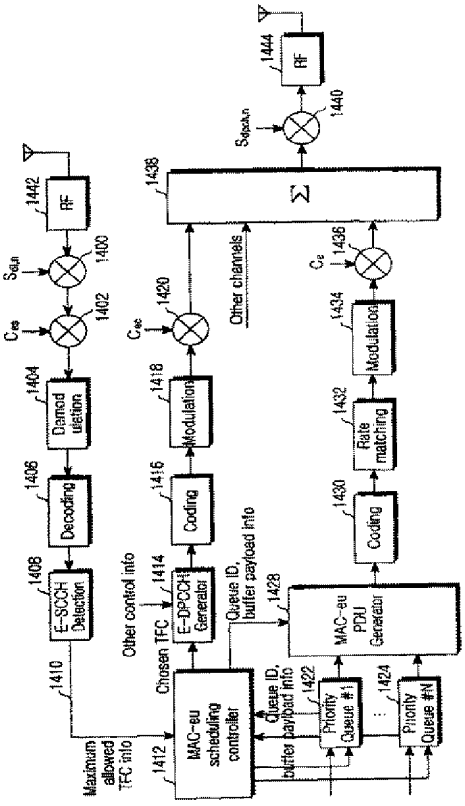


FIG.14

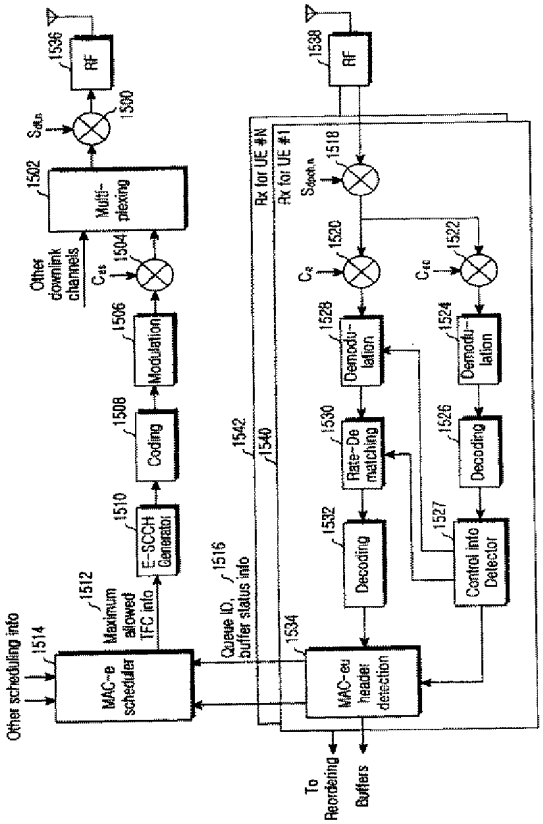


FIG.15

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(19) United States

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Heo et al. (43) Pub. Date: Mar. 3, 2005

(54) METHOD AND APPARATUS FOR SCHEDULING ASSIGNMENT OF UPLINK PACKET TRANSMISSION IN MOBILE TELECOMMUNICATION SYSTEM

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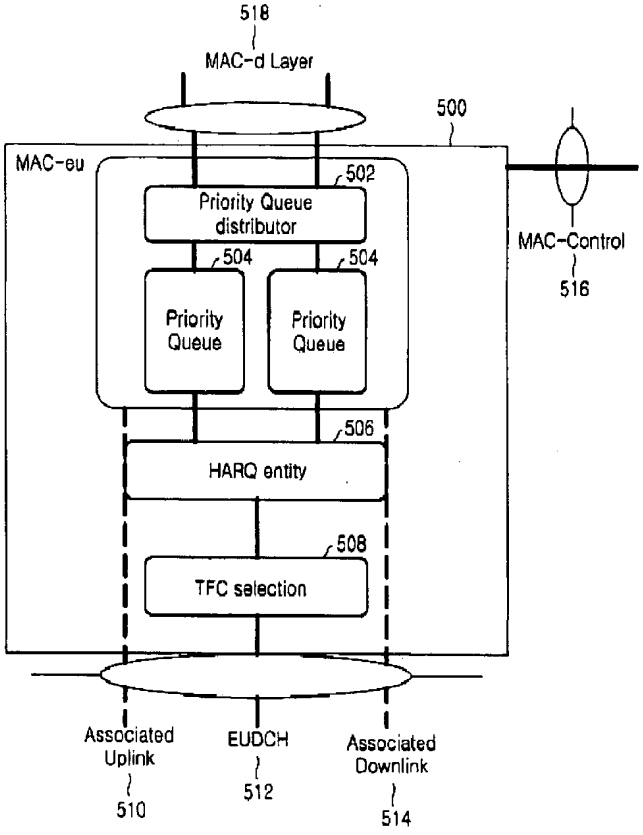
(52) **U.S. Cl.** ..... **370/395.4**; 370/412

(57) **ABSTRACT**

A method and an apparatus for reporting a buffer status of a buffer storing packet data to be transmitted by a user equipment for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service are disclosed. A user equipment stores packet data having a priority corresponding to a plurality of priority queues having inherent priorities and relating to at least one service, and transmits buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues. Herein, the user equipment inserts the buffer status information into a header part of a protocol data unit for the uplink packet data service, inserts the packet data into a payload part of the protocol data unit, and then transmits the protocol data unit.



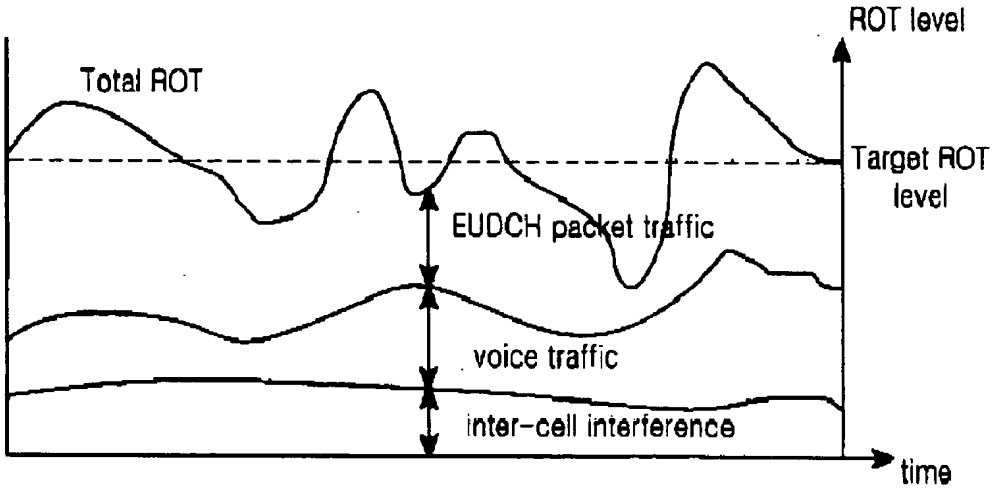

ROT level
Total ROT
Target ROT level
EUDCH packet traffic
voice traffic
inter-cell interference
time

FIG.1A

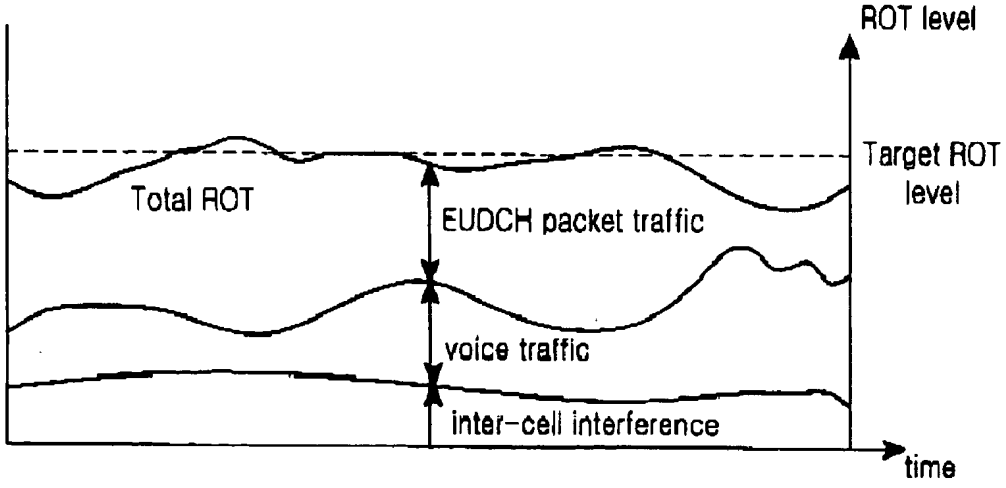

ROT level
Target ROT level
Total ROT
EUDCH packet traffic
voice traffic
inter-cell interference
time

FIG.1B

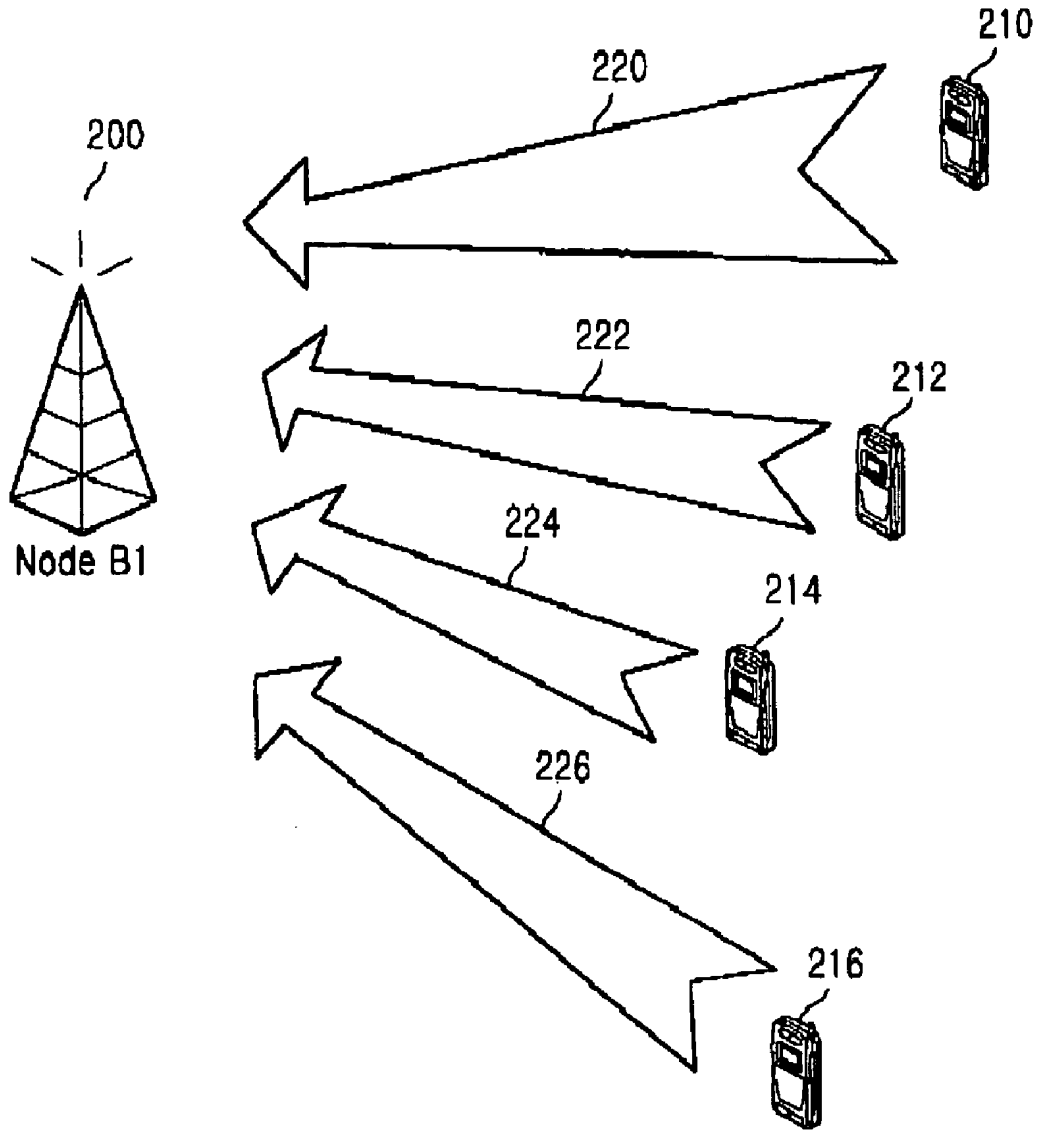



FIG.2

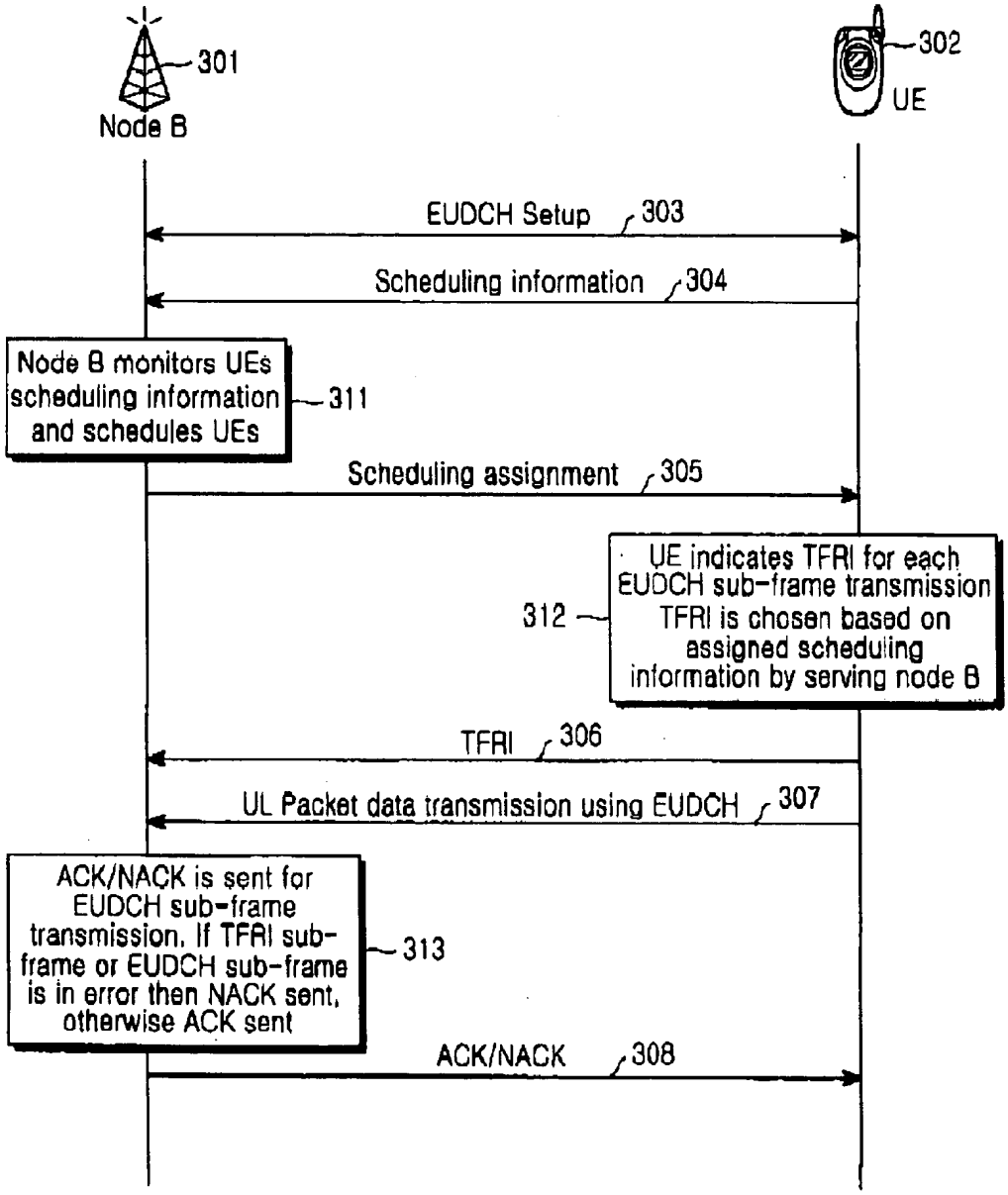

301
Node B
302
UE
EUDCH Setup
303
Scheduling information
304
Node B monitors UEs scheduling information and schedules UEs
311
Scheduling assignment
305
UE indicates TFRI for each EUDCH sub-frame transmission TFRI is chosen based on assigned scheduling information by serving node B
312
TFRI
306
UL Packet data transmission using EUDCH
307
ACK/NACK is sent for EUDCH sub-frame transmission. If TFRI sub-frame or EUDCH sub-frame is in error then NACK sent, otherwise ACK sent
313
ACK/NACK
308

FIG.3

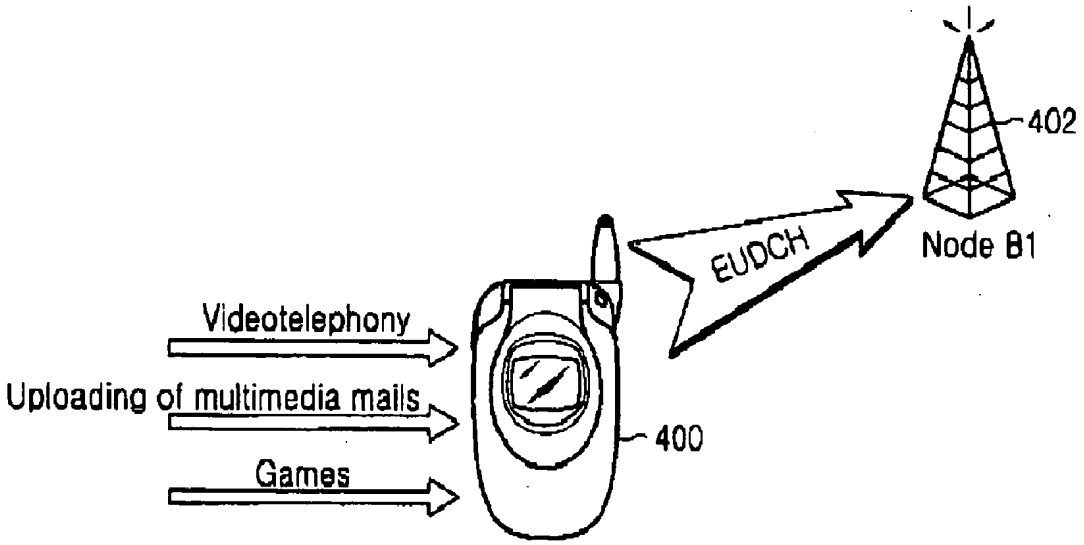

402
Node B1
EUDCH
Videotelephony
Uploading of multimedia mails
Games
400

FIG.4

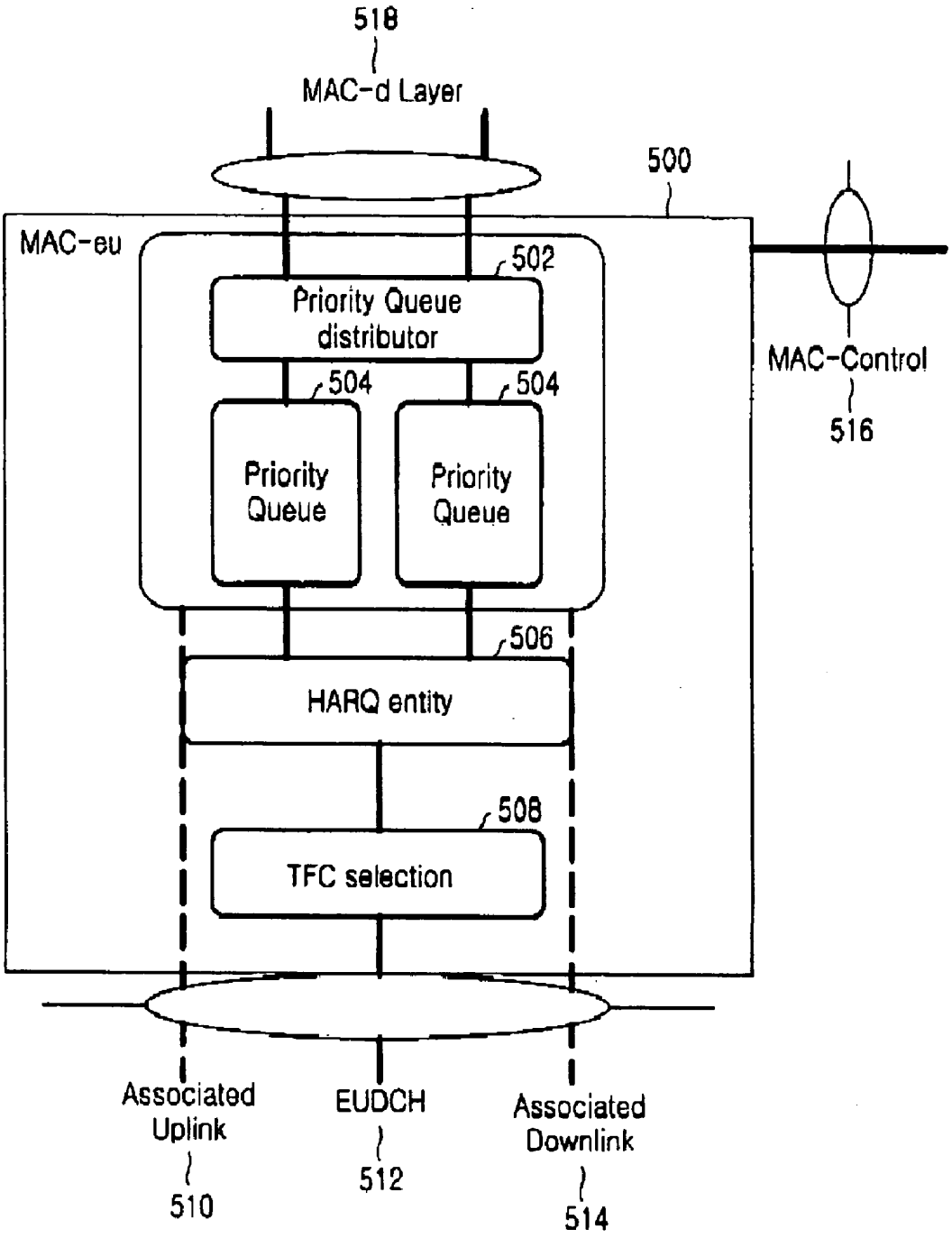

518
MAC-d Layer
500
MAC-eu
502
Priority Queue distributor
504
504
Priority Queue
Priority Queue
MAC-Control
516
506
HARQ entity
508
TFC selection
Associated Uplink
510
EUDCH
512
Associated Downlink
514

FIG.5

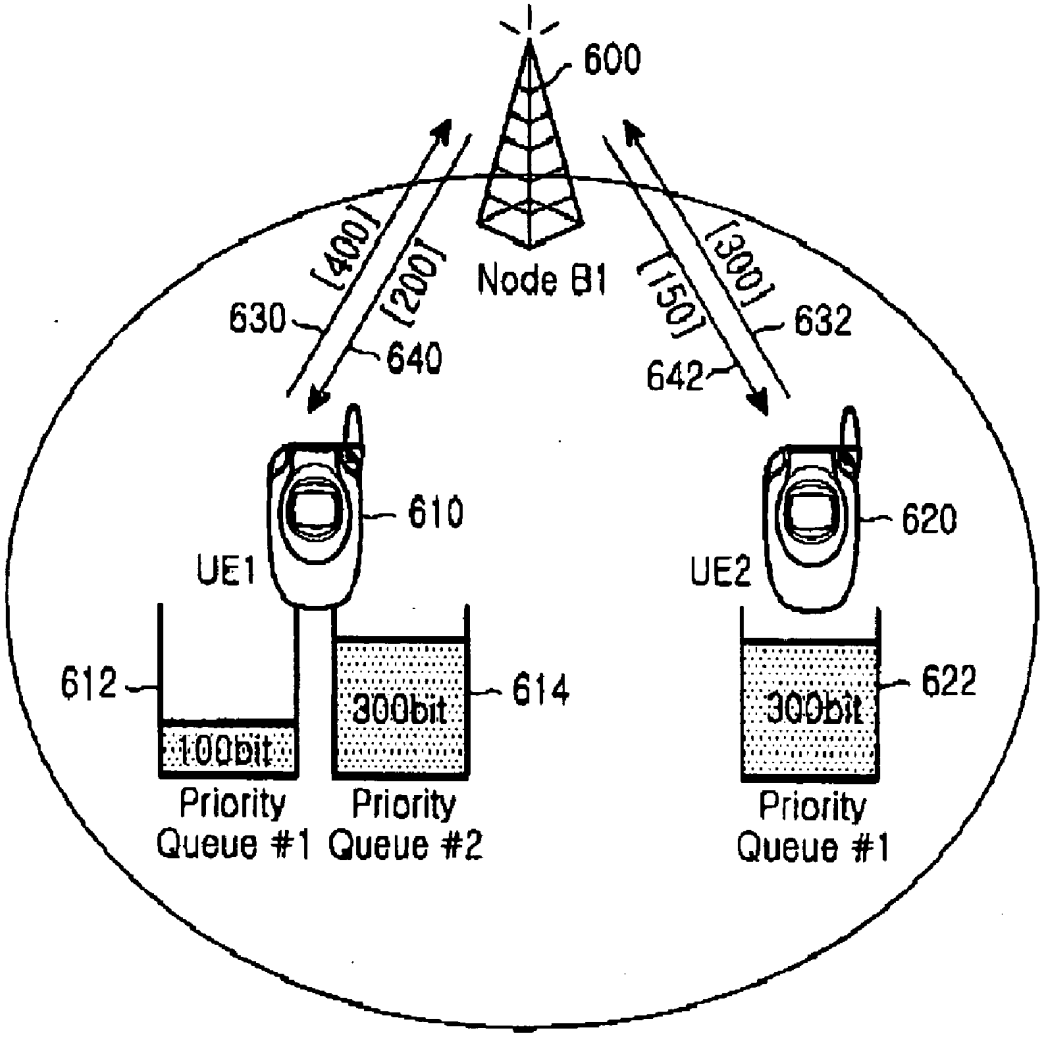

600
Node B1
[400]
[200]
[150]
[300]
630
640
642
632
610
620
UE1
UE2
612
614
622
100bit
300bit
300bit
Priority Queue #1
Priority Queue #2
Priority Queue #1

FIG.6

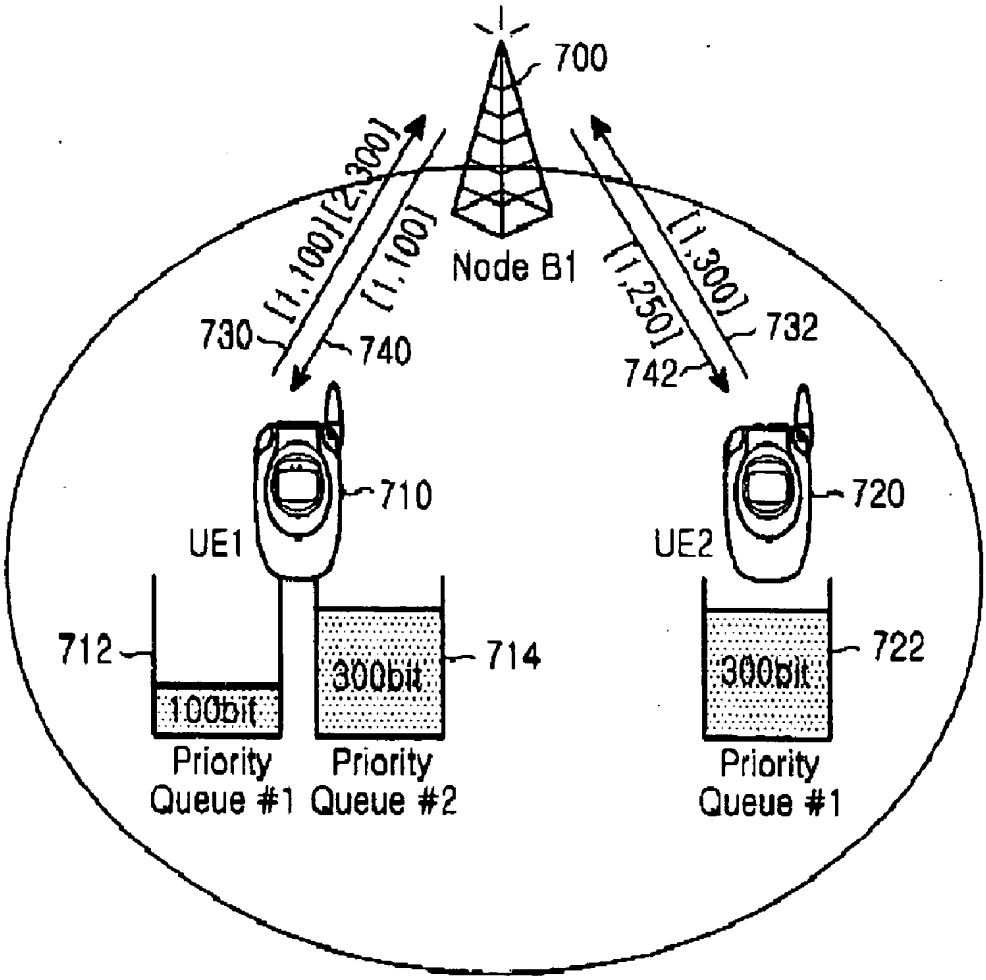

700
Node B1
[1,100][2,300]
[1,100]
730
740
[1,250]
[1,300]
742
732
710
UE1
720
UE2
712
100bit
300bit
714
300bit
722
Priority Queue #1
Priority Queue #2
Priority Queue #1

FIG.7

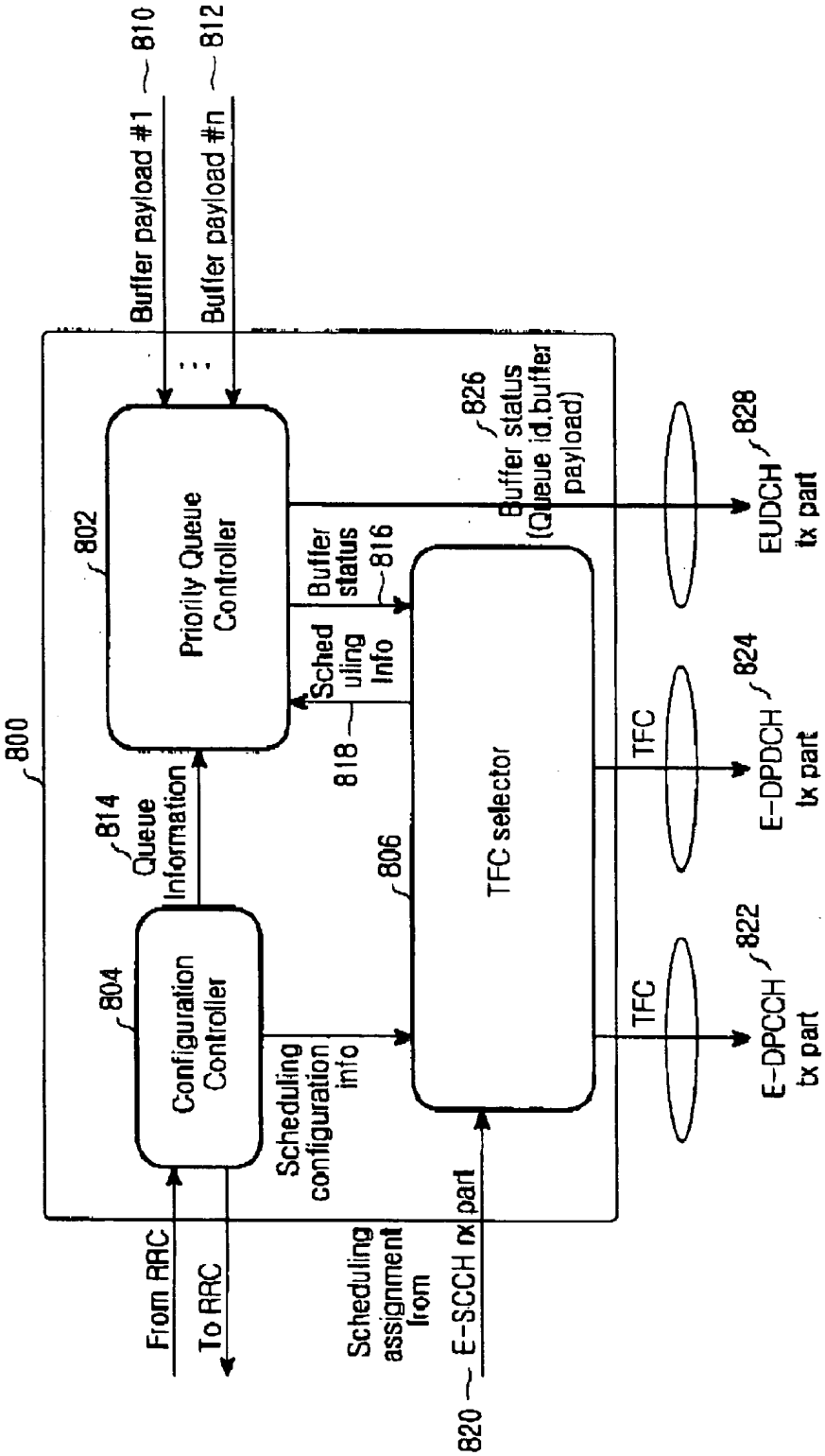

800
Buffer payload #1
810
Buffer payload #n
812
802
Priority Queue Controller
826
Buffer status (Queue id.buffer payload)
828
EUDCH tx part
Buffer status
816
Sched uling Info
818
814
Queue Information
806
TFC selector
TFC
824
E-DPDCH tx part
804
Configuration Controller
Scheduling configuration info
TFC
822
E-DPCCH tx part
From RRC
To RRC
Scheduling assignment from
E-SCCH rx part
820

FIG.8

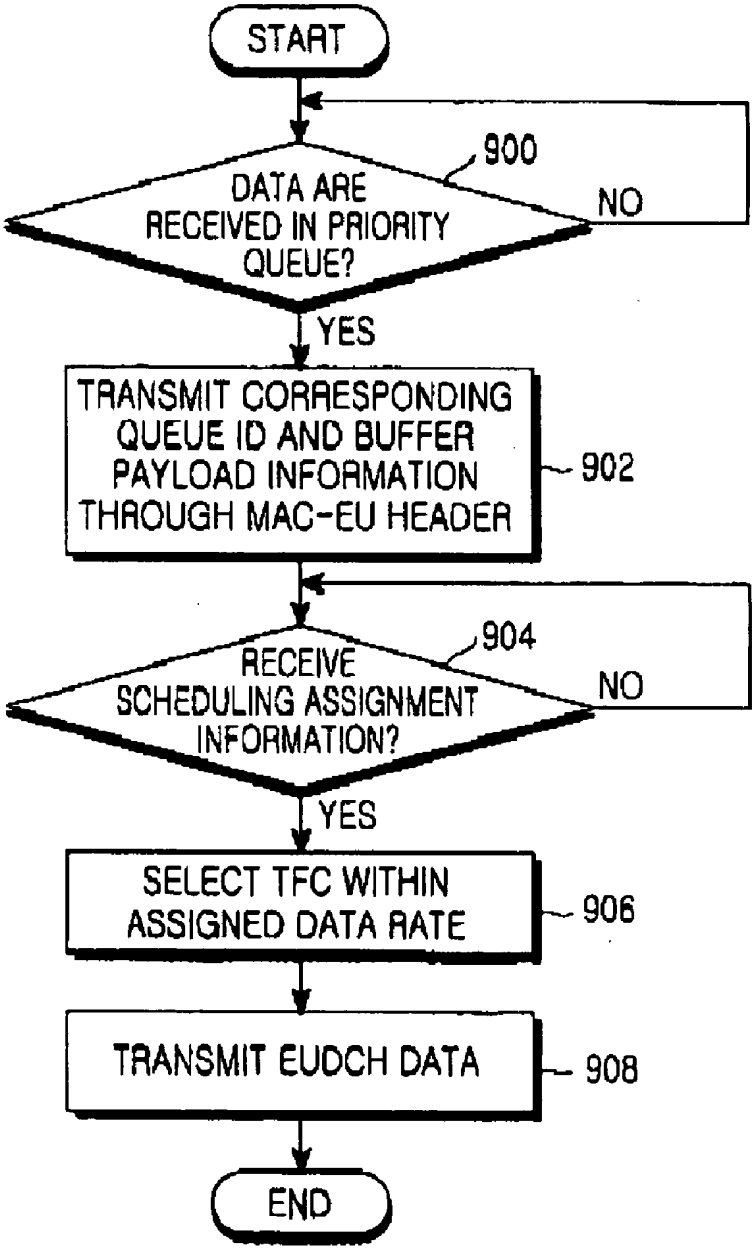

START
900
DATA ARE RECEIVED IN PRIORITY QUEUE?
NO
YES
TRANSMIT CORRESPONDING QUEUE ID AND BUFFER PAYLOAD INFORMATION THROUGH MAC-EU HEADER
902
904
RECEIVE SCHEDULING ASSIGNMENT INFORMATION?
NO
YES
SELECT TFC WITHIN ASSIGNED DATA RATE
906
TRANSMIT EUDCH DATA
908
END

FIG.9

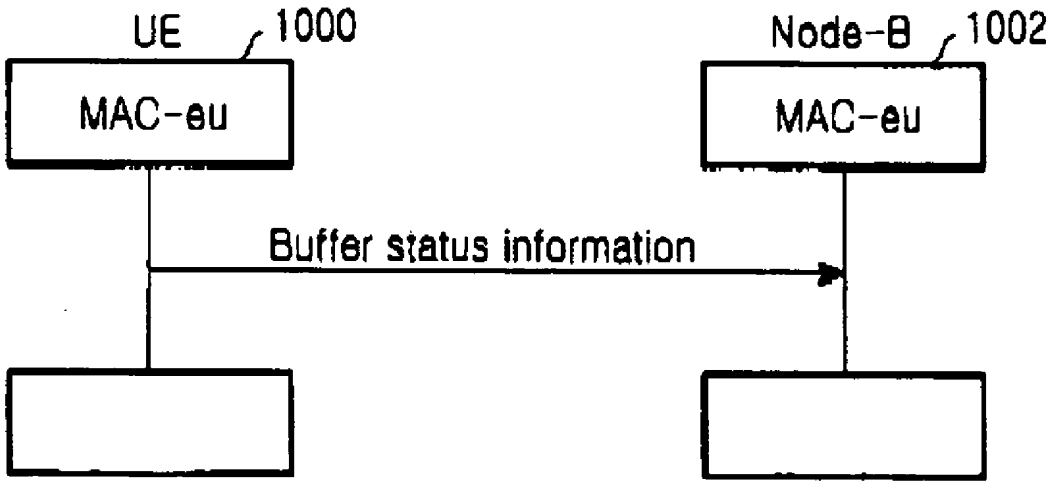



FIG.10

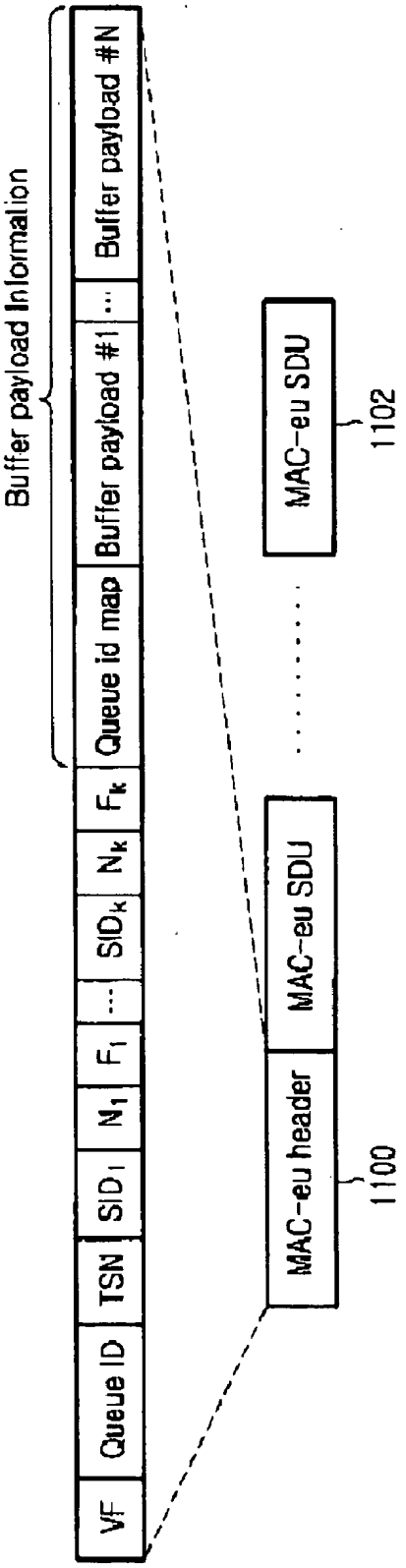

Buffer payload Information
VF
Queue ID
TSN
SID1
N1
F1
...
SIDk
Nk
Fk
Queue id map
Buffer payload #1
...
Buffer payload #N
MAC-eu header
MAC-eu SDU
1100
MAC-eu SDU
1102

FIG.11

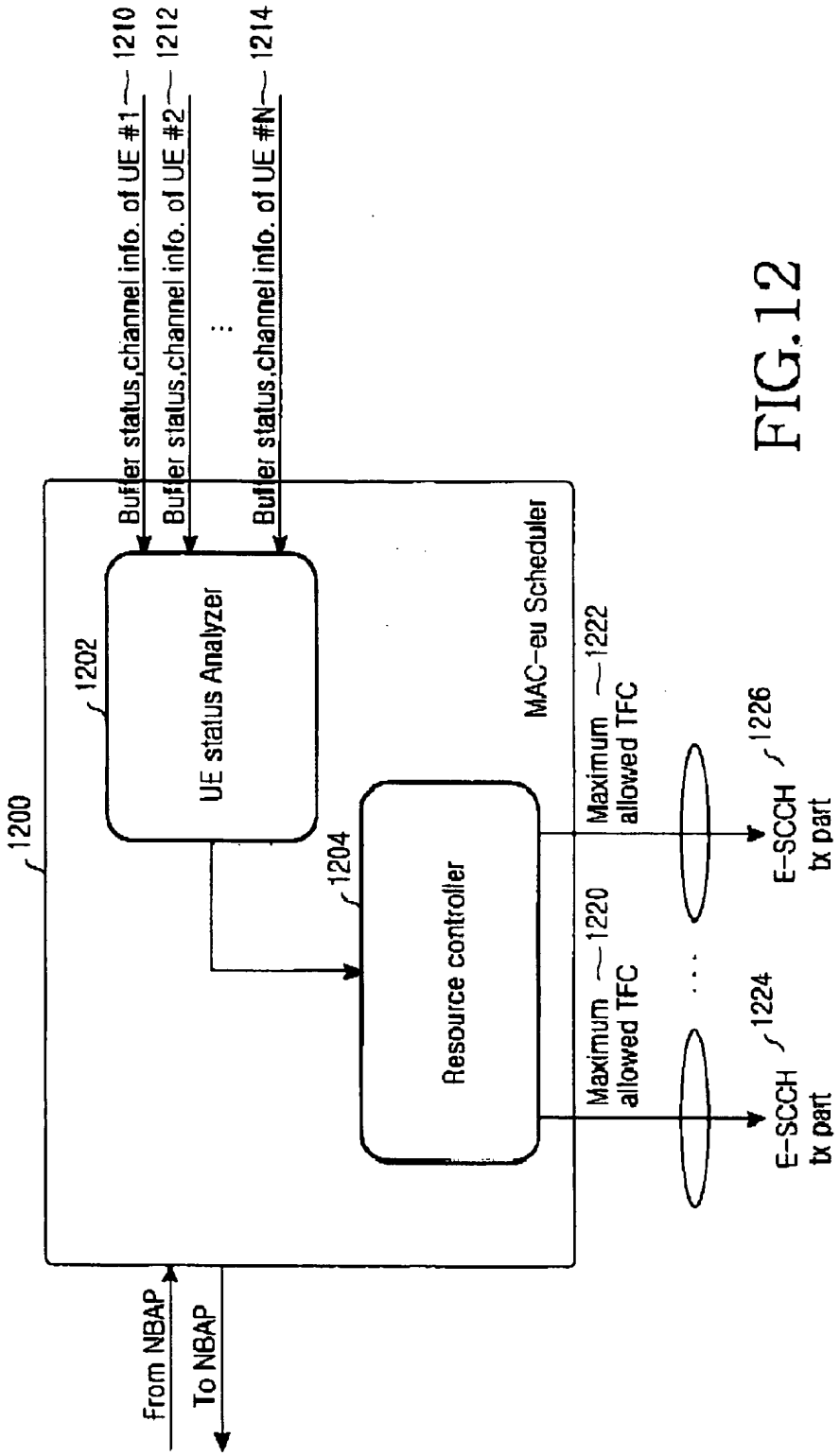

1200
1202
UE status Analyzer
1204
Resource controller
MAC-eu Scheduler
Buffer status,channel info. of UE #1
1210
Buffer status,channel info. of UE #2
1212
Buffer status,channel info. of UE #N
1214
Maximum allowed TFC
1220
Maximum allowed TFC
1222
E-SCCH tx part
1224
E-SCCH tx part
1226
From NBAP
To NBAP

FIG. 12

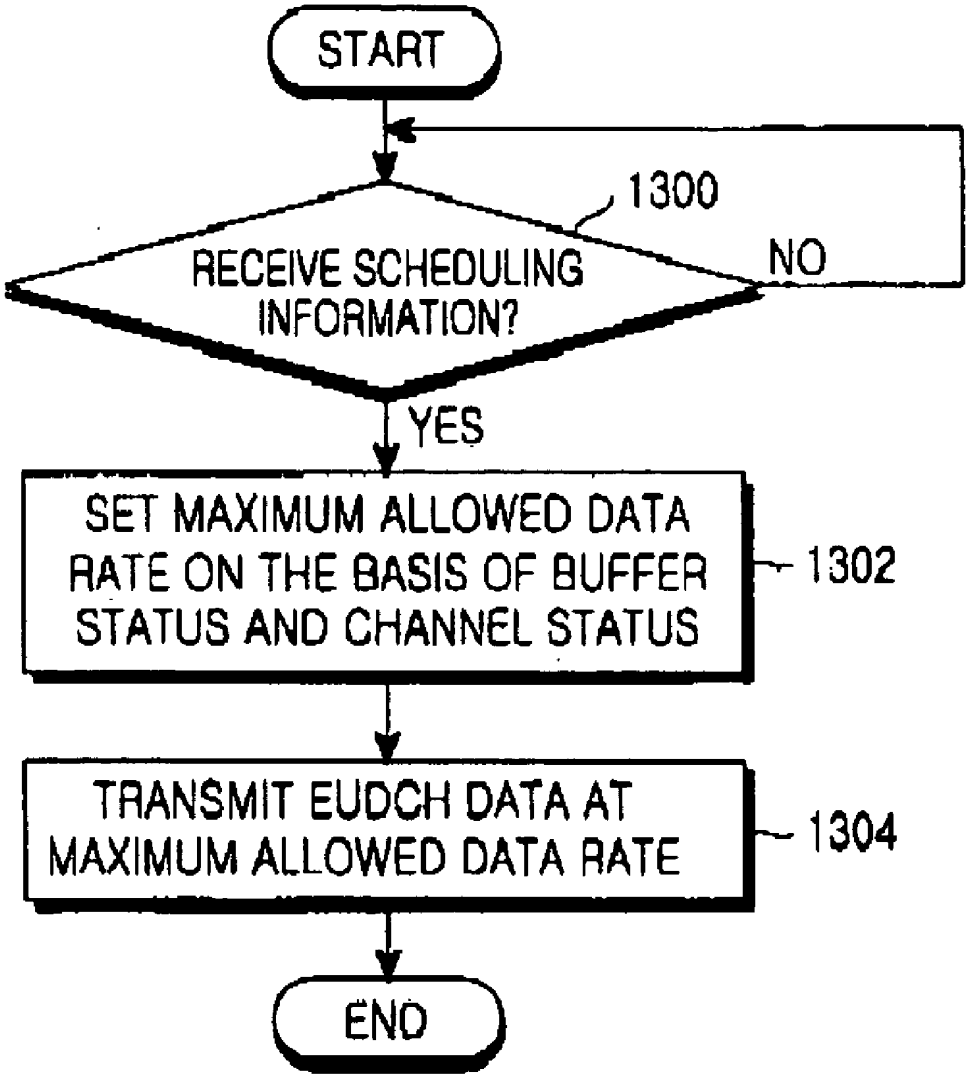

START
1300
RECEIVE SCHEDULING INFORMATION?
NO
YES
SET MAXIMUM ALLOWED DATA RATE ON THE BASIS OF BUFFER STATUS AND CHANNEL STATUS
1302
TRANSMIT EUDCH DATA AT MAXIMUM ALLOWED DATA RATE
1304
END

FIG.13

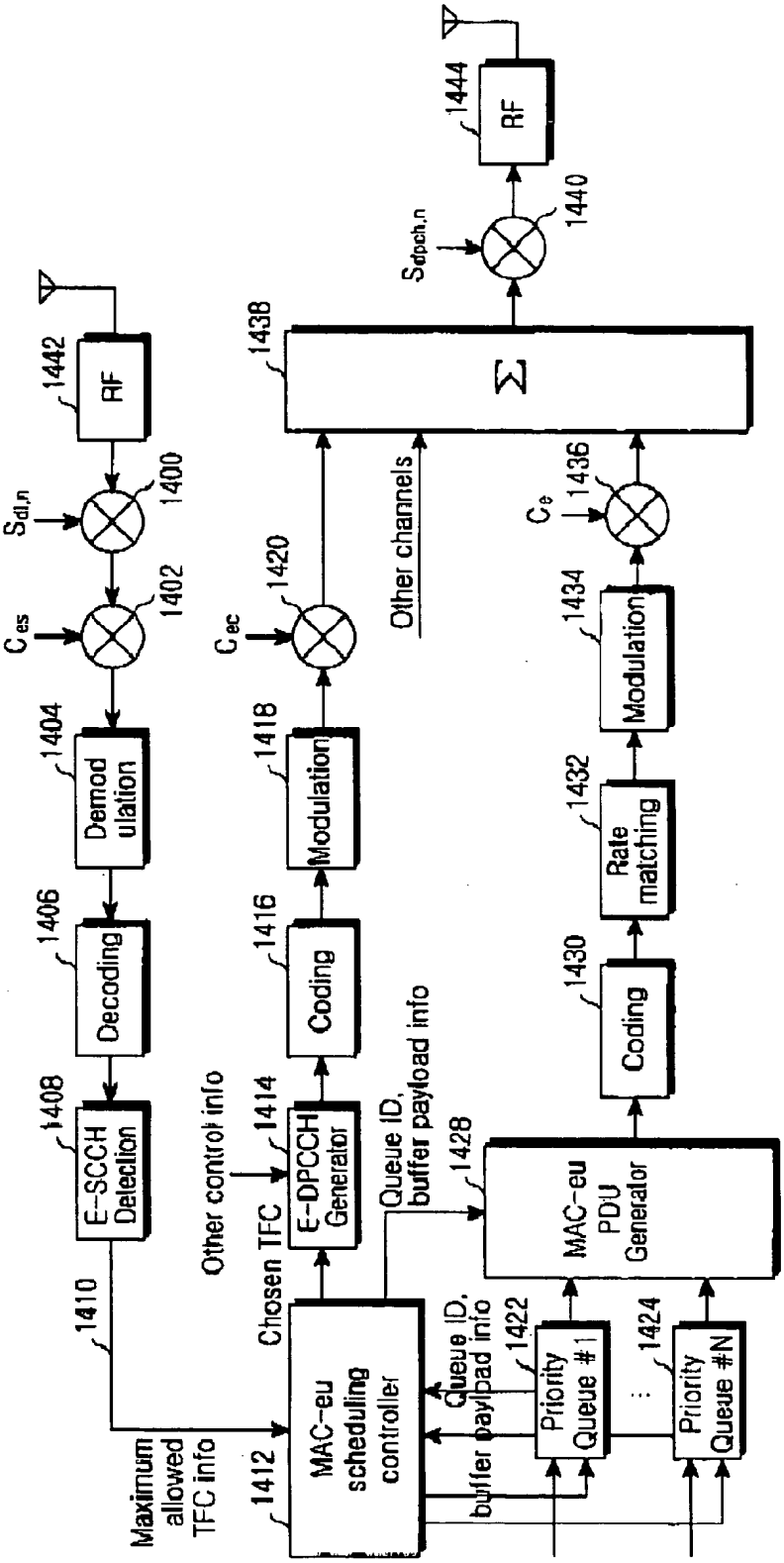

RF
1442
1444
1400
1402
1440
1438
1420
1436
1434
1418
1404
1406
1416
1432
1408
1414
1430
1428
1410
1422
1424
1412
$S_{dl,n}$
$C_{es}$
$C_{ec}$
$S_{dpch,n}$
$C_e$
Demod ulation
Decoding
E-SCCH Detection
Coding
Modulation
Rate matching
E-DPCCH Generator
MAC-eu PDU Generator
MAC-eu scheduling controller
Priority Queue #1
Priority Queue #N
Other channels
Other control info
Chosen TFC
Queue ID, buffer payload info
Maximum allowed TFC info
Σ

FIG. 14

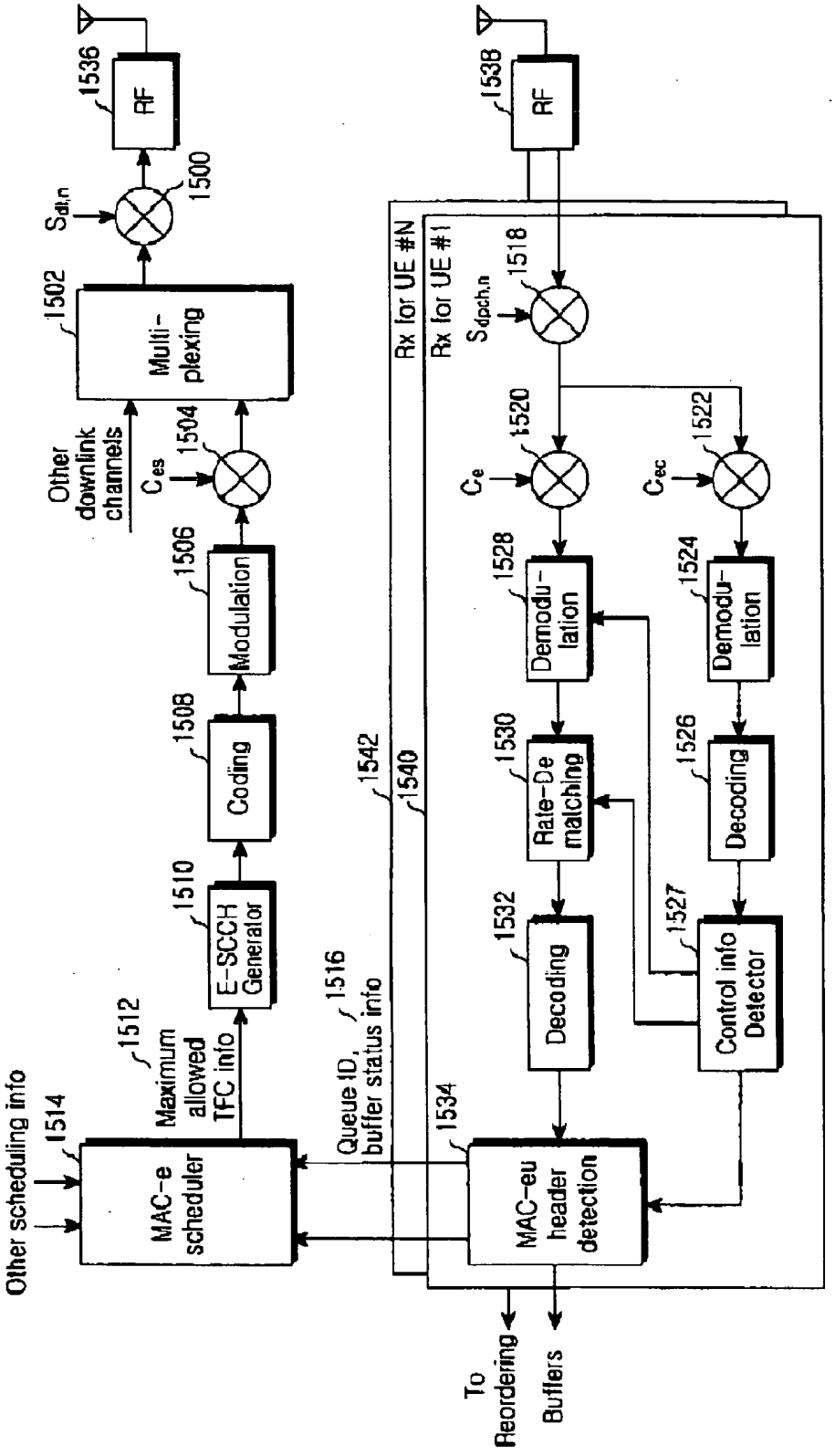

Other scheduling info
1514
MAC-e scheduler
1512
Maximum allowed TFC info
1510
E-SCCH Generator
1508
Coding
1506
Modulation
1504
$C_{es}$
Other downlink channels
1502
Multi-plexing
1500
$S_{dl,n}$
1536
RF
1516
Queue ID, buffer status info
1542
1540
Rx for UE #N
Rx for UE #1
1538
RF
1518
$S_{dpch,n}$
1520
$C_e$
1522
$C_{ec}$
1528
Demodu-lation
1524
Demodu-lation
1530
Rate-De matching
1526
Decoding
1532
Decoding
1527
Control info Detector
1534
MAC-eu header detection
To Reordering Buffers

FIG.15

# METHOD AND APPARATUS FOR SCHEDULING ASSIGNMENT OF UPLINK PACKET TRANSMISSION IN MOBILE TELECOMMUNICATION SYSTEM

## PRIORITY

[0001] This application claims priority to an application entitled "Method And Apparatus For Scheduling Assignment Of Uplink Packet Transmission In Mobile Telecommunication System" filed in the Korean Intellectual Property Office on Aug. 26, 2003 and assigned Serial No. 2003-59172, the contents of which are hereby incorporated by reference.

## BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a mobile telecommunication system, and more particularly to a method and an apparatus for efficiently transceiving scheduling assignment information for transmitting packet data through an uplink (UL).

[0004] 2. Description of the Related Art

[0005] An asynchronous Wideband Code Division Multiple Access (hereinafter, referred to as a WCDMA) communication system employs an Enhanced Uplink Dedicated Channel (hereinafter, referred to as an EUDCH or E-DCH) in order to support a high speed packet data service through an uplink. The EUDCH is a channel proposed to improve the performance of a packet transmission in an uplink communication in an asynchronous code division multiple access communication system. The EUDCH-related technology includes new technologies for a more reduced Transmission Time Interval (TTI) together with the Adaptive Modulation and Coding (AMC) method and the Hybrid Automatic Retransmission Request (HARQ) method already used in a High Speed Downlink packet access (HSDPA). Further, a Node B control scheduling of an uplink channel is used. The Node B control scheduling for the uplink is very different from a scheduling for a downlink.

[0006] Since uplink signals transmitted from a plurality of user equipments (hereinafter, referred to as UEs) do not maintain orthogonality between the uplink signals, the uplink signals function as interference signals between themselves. Therefore, as the number of uplink signals received in the Node B increase, the number of interference signals for uplink signals transmitted from a specific UE also increases. Accordingly, as the number of the interference signals with respect to the uplink signals transmitted from the specific UE increases, the reception performance of the Node B is reduced. In order to overcome such a problem, uplink transmission power may be increased. However, an uplink signal having increased transmission power also functions as an interference signal with respect to another signal. Accordingly, the Node B limits the number of a receivable uplink signals while ensuring its own reception performance. Equation (1) represents the number of the receivable uplink signal while the reception performance of the Node B is ensured.

$$ROT = \frac{I_o}{N_o} \quad (1)$$

[0007] In Equation (1), $I_o$ represents an entire reception wideband power spectral density of the Node B and $N_o$ represents a thermal noise power spectral density of the Node B. Accordingly, the ROT is a radio resource capable of being assigned by the Node B for the EUDCH packet data service in an uplink.

[0008] **FIGS. 1A and 1B** show variations of an uplink radio resource assigned by a Node B. As shown in **FIGS. 1A and 1B**, the uplink radio resource assigned by the Node B is obtained by the sum of inter-cell interference (hereinafter, referred to as an ICI), voice traffic, and EUDCH packet traffic.

[0009] **FIG. 1A** shows variation of the total ROT when Node B scheduling is not used. Since scheduling is not performed for the EUDCH packet traffic, the total ROT grows larger than a target ROT when a plurality of UEs transmit the packet data at a high data rate at the same time. Herein, the reception performance of the uplink signal is reduced.

[0010] **FIG. 1B** shows variation of the total ROT when Node B scheduling is used, thereby preventing the multiple UEs from transmitting the packet data at a high data rate at the same time. That is, the Node B scheduling enables a high data rate to be permitted to a specific UE and a low data rate to be permitted to other UEs, thereby preventing the total ROT from exceeding the target ROT. Accordingly, Node B scheduling can always maintain constant reception performance.

[0011] The Node B notifies each UE of information regarding whether or not EUDCH data can be transmitted by means of a request data rate of UEs using the EUDCH or channel status information representing transmission quality of an uplink. Also, the Node B adjusts the EUDCH data rate. Further, in order to improve the performance of a mobile communication system, the Node B scheduling assigns the data rate to the UEs so that the total ROT of the Node B does not exceed the target ROT. For example, the Node B may assign a low data rate to a UE in a position remote from the Node B and a high data rate to a UE in a position near to the Node B.

[0012] **FIG. 2** is a view illustrating a basic concept regarding circumstances in which a Node B scheduling is used in an EUDCH. In **FIG. 2**, Node B **200** supports the EUDCH and reference numerals **210**, **212**, **214**, and **216** represent UEs transmitting the EUDCH. When a data rate of a certain UE increases, reception power received in the Node B **200** from the UE increases. Accordingly, a ROT of the UE occupies a large portion of the total ROT. In contrast, when a data rate of another UE is reduced, reception power received in the Node B **200** from another UE is reduced. Accordingly, a ROT of another UE occupies a small portion of the total ROT. The Node B **200** performs the Node B scheduling for the EUDCH packet data in consideration of the relation between the data rates and a radio resource requested by the UEs **210**, **212**, **214**, and **216**.

[0013] In **FIG. 2**, the UEs **210**, **212**, **214**, and **216** transmit the packet data with different uplink transmission powers from each other according to the distance between the Node B **200** and the UEs **210**, **212**, **214**, and **216**. UE **210**, in the furthest position from the Node B **200**, transmits the packet data with the highest transmission power **220** of an uplink channel. In contrast, UE **214**, in the nearest position to the Node B **200**, transmits the packet data with the lowest transmission power **224** of an uplink channel. In order to improve the performance of a mobile communication system while maintaining the total ROT and reducing an ICI for another cell, the Node B performs scheduling so that the transmission power intensity of the uplink channel is inversely proportional to the data rate, thereby assigning a relatively lower data rate to the UE **210** having the highest transmission power of an uplink channel and a relatively higher data rate to the UE **214** having the lowest transmission power of an uplink channel.

[0014] **FIG. 3** is a flow diagram illustrating a basic transmission/reception procedure between a UE **302** transmitting an EUDCH and a Node B **301** including the UE **302**.

[0015] In step **303**, a setup of an EUDCH is accomplished between the Node B **301** and the UE **302**. The setup step includes a transmission step of messages through a dedicated transport channel. When the EUDCH setup is accomplished, the UE **302** informs the Node B **301** of scheduling information at step **304**. The scheduling information may include UE transmission power information enabling uplink channel information to be understood, extra information of transmission power capable of being transmitted by a UE, and the amount of data stored in a buffer of a UE that must be transmitted.

[0016] In step **311**, the Node B **301** monitors the scheduling information of the UE **302** and schedules the UE **302**. When the Node B **301** determines to permit an uplink data transmission to the UE **302** in step **311**, the Node B **301** transmits scheduling assignment information containing an assigned data rate and a transmission timing to the UE **302** in step **305**. In step **312**, the UE **302** determines a Transport Format (TF) such as a data rate for a EUDCH transmission based on the scheduling assignment information and chooses a Transport Format Resource Indicator (TFRI) indicating the TF. In step **307**, the UE **302** transmits EUDCH data by means of the TFRI. Further, the TFRI, which is related information representing the TF of the EUDCH data, is transmitted to the Node B **301** in step **306** together with the EUDCH data. In step **313**, the Node B **301** determines whether or not an error exists in the TFRI and the EUDCH data. As a result of the determination, when the error exists in at least one of the TFRI and the EUDCH data, the Node B **301** transmits an NACK to the UE **302** through an ACK/NACK channel, in step **308**. In contrast, when any error does not exist in the TFRI and the EUDCH data, the Node B **301** transmits an ACK to the UE **302** through an ACK/NACK channel, in step **308**.

[0017] The Node B **301** decides a data rate to be assigned to a UE on the basis of the scheduling information. Herein, the Node B **301** assigns a proper data rate and transmission timing to multiple UEs using an EUDCH. Further, in the scheduling, the Node B **301** assigns a resource to each UE in order to prevent a ROT value of an uplink from exceeding a target ROT value. Herein, the Node B **301** assigns many resources to a UE having a good channel condition in order to improve the entire performance of a system.

[0018] **FIG. 4** is a view showing the types of data transmitted from a UE to a Node B for an uplink packet data service.

[0019] As shown in **FIG. 4**, a UE **400** can transmit voice and image traffic, packet data, data regarding a game, etc., to a Node B **402** through an EUDCH. The data transmitted from the UE as described above requires different quality of service (QoS) according to the types of the data. Accordingly, it is necessary to provide a method by which the Node B **402** performs a scheduling and assigns a radio resource according to quality of service required by data to be transmitted

## SUMMARY OF THE INVENTION

[0020] Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the prior art, and it is an object of the present invention is to provide a method and an apparatus for assigning a radio resource according to quality of service required by data to be transmitted.

[0021] It is another object of the present invention is to provide a method and an apparatus for assigning many radio resources with respect to data requesting high quality of service and a few radio resources with respect to data requesting low quality of service.

[0022] It is further object of the present invention is to provide a method and an apparatus for efficiently using a radio resource of a mobile communication system by assigning radio resources different from each other according to quality of service.

[0023] In order to accomplish the aforementioned objects, according to one aspect of the present invention, there is provided a method for reporting status of a buffer storing packet data to be transmitted by a user equipment for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method including storing packet data having a priority corresponding to a plurality of priority queues having inherent priorities and relating to at least one service; and transmitting buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues.

[0024] In order to accomplish the aforementioned objects, according to another aspect of the present invention, there is provided a method which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method including generating a protocol data unit including a header part and a payload part for the uplink packet data service; and inserting the scheduling information into the header part, inserting packet data for the uplink packet data service into the payload part, and transmitting the protocol data unit.

[0025] In order to accomplish the aforementioned objects, according to a further aspect of the present invention, there is provided an apparatus for reporting status of a buffer

storing packet data to be transmitted by a user equipment for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus including a plurality of priority queues having same priorities, for storing packet data relating to at least one service; a scheduling controller for generating buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues; and a transmission unit for transmitting the buffer status information.

[0026] In order to accomplish the aforementioned objects, according to still another aspect of the present invention, there is provided an apparatus which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus including a plurality of priority queues having same priorities, for storing packet data relating to at least one service; and a protocol data unit generator for generating a protocol data unit containing a header part and a payload part for the uplink packet data service, receiving packet data outputted from the priority queues, inserting the scheduling information into the header part, inserting packet data into the payload part, and transmitting the protocol data unit.

[0027] In order to accomplish the aforementioned objects, according to yet a further aspect of the present, there is provided a Node B for scheduling an uplink packet data service from a user equipment in a mobile communication system, the Node B including a reception unit for a protocol data unit containing a header part and a payload part for the uplink packet data service; a header detection unit for detecting scheduling information for the uplink packet data service from the header part of the protocol data unit and detecting packet data from the payload part of the protocol data unit; a scheduler for generating scheduling assignment information for the uplink packet data service according to the scheduling information; and a transmission unit for transmitting the scheduling assignment information to the user equipment.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0029] **FIG. 1A** is a view showing variations of an uplink radio resource of a Node B when a Node B control scheduling is not used;

[0030] **FIG. 1B** is a view showing variations of an uplink radio resource of a Node B when a Node B control scheduling is used;

[0031] **FIG. 2** is a view illustrating a UE and a Node B performing uplink packet transmission;

[0032] **FIG. 3** is a view showing information exchanged between a UE and a Node B in order to perform uplink packet transmission;

[0033] **FIG. 4** is a view showing the types of data transmitted from a UE to a Node B for an uplink packet data service;

[0034] **FIG. 5** is a view showing a structure of a logical layer of a UE according to a preferred embodiment of the present invention;

[0035] **FIG. 6** is a view illustrating transmission/reception of scheduling assignment information between a UE and a Node B according to one embodiment of the present invention;

[0036] **FIG. 7** is a view illustrating transmission/reception of scheduling assignment information between a UE and a Node B according to another embodiment of the present invention;

[0037] **FIG. 8** is a view showing a structure of a logical layer of a UE according to a preferred embodiment of the present invention;

[0038] **FIG. 9** is a flowchart illustrating an operation performed in a structure of a logical layer of a UE according to a preferred embodiment of the present invention;

[0039] **FIG. 10** is a view illustrating an operation by which buffer status information is transmitted from a logical layer of a UE to a logical layer of a Node B according to a preferred embodiment of the present invention;

[0040] **FIG. 11** is a view showing a structure of an EUDCH transmitting a buffer status information of a UE according to a preferred embodiment of the present invention;

[0041] **FIG. 12** is a view showing a structure of a logical layer of a Node B according to a preferred embodiment of the present invention;

[0042] **FIG. 13** is a flowchart showing an operation performed in a structure of a logical layer of a Node B according to a preferred embodiment of the present invention;

[0043] **FIG. 14** is a block diagram illustrating a transmission/reception operation performed by a UE according to a preferred embodiment of the present invention; and

[0044] **FIG. 15** is a block diagram illustrating a transmission/reception operation performed by a Node B according to a preferred embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0045] Hereinafter, a preferred embodiment according to the present invention will be described with reference to the accompanying drawings. In the following description of the present invention, a detailed description of known functions and configurations incorporated herein will be omitted when it may make the subject matter of the present invention unclear.

[0046] A Universal Mobile Telecommunication Service (hereinafter, referred to as a UMTS), one of the 3rd Generation Partnership Project (3GPP) mobile communication services, is based on a communication standard of a Global System for Mobile Communication (hereinafter, referred to as a GSM) and a General Packet Radio Service (GPRS) employs a wideband CDMA technology, in contrast to the GSM employing a Time Division Multiple Access (TDMA). A UMTS Terrestrial Radio Access Network (hereinafter, referred to as a UTRAN) includes Node Bs containing a

plurality of cells and a Radio Network Controller (hereinafter, referred to as a RNC) managing radio resources of the Node Bs.

[0047] An interface between a UE and a RNC is called an Uu interface and is classified as a control plane for exchanging control and signaling signals and a user plane for transmitting data traffic. The control plane includes a radio resource control (RRC) layer, a radio link control (RLC) layer, a media access control (MAC) layer, and a physical (hereinafter, referred to as a PHY) layer. Further, the user plane includes a packet data control protocol (PDCP) layer, an RLC layer, a MAC layer, and a PHY layer. Herein, the PHY layer is located in each cell and the layers between a MAC layer and a RRC layer are located in a RNC.

[0048] Particularly, a portion related to a user plane in a MAC layer is called a MAC-d and a portion related to a control plane is called a MAC-c. User data to be transmitted through a dedicated transport channel is generated into a transmission block having a desired size through a MAC-d layer. When the user data is transmitted through an EUDCH, the transmission block passes through a MAC-eu portion in the MAC layer. A MAC-eu layer performs a process a Node B control scheduling, HARQ, etc., for an EUDCH before transmitting data sent from a MAC-d layer to a PHY layer.

[0049] **FIG. 5** is a view showing a structure of a MAC-eu layer of a UE transmitting an EUDCH according to a preferred embodiment of the present invention.

[0050] The MAC-eu layer **500** of the UE includes a priority queue distributor **502** and a priority queues (PQs) **504**, and receives data to be transmitted to a Node B from a MAC-d layer **518**. The received data is sent to the priority queue distributor **502** of the MAC-eu layer **500**. The priority queue distributor **502** determines a priority for the received data and buffers the data in a priority queue, which corresponds to the determined priority, from among the priority queues **504**.

[0051] The priority queues **504** are used in storing data according to a priority of a service to be provided and have inherent queue identifiers (hereinafter, referred to as QIDs) respectively. That is, each of the priority queues **504** is related to at least one service and stores data having different priorities. **FIG. 5** shows two priority queues **504**, but the number of the priority queues **504** is randomly determined by a MAC control signal **516** according to the type and number of services being provided. That is, when a priority for data to be transmitted to the Node B is classified as multiple steps, the number of the priority queues **504** increases. The priority is determined according to a transmission time point (i.e., required delay) at which data is to be transmitted to the Node B. That is, data which must be transmitted to the Node B within a rapid time period has a high priority, and data which does not have the necessity of being transmitted to the Node B within a rapid time period has a low priority.

[0052] The priority queue distributor **502** determines a priority for the received data and sends the data to one of the priority queues **504** according to the determined priority. In this way, data having the same priority is sent to the same priority queue. The priority queues **504** store the received data before a resource is assigned by the scheduling of the Node B.

[0053] In order to request a scheduling assignment from the Node B, the MAC-eu layer **500** transmits scheduling information, which contain a buffer status representing the amount of the data stored in the priority queues **504** and a channel status representing the transmission quality of an uplink, through an EUDCH related uplink **510**. When the Node B transmits scheduling assignment information to the UE through an EUDCH related downlink **514**, a Transport format combination (hereinafter, referred to as a TFC) selection part **508** determines a TFC by means of the scheduling assignment information, reads the data from the priority queues **504** by means of the determined TFC, and transmits the read data through an EUDCH **512**. Herein, the UE first transmits data having a high priority stored in the priority queues **504**. Therefore, a transmission time can be differently designated according to the priority. Meanwhile, an HARQ entity **506** interprets an ACK/NACK received through the related downlink **514** with respect to the transmitted data, discards data stored in a corresponding priority queue when an ACK is received, and retransmits data stored in a corresponding priority queue when an NACK is received.

[0054] **FIG. 6** is a view illustrating an operation by which two UEs request a scheduling assignment to a Node B according to one embodiment of the present invention.

[0055] In **FIG. 6**, the UE **610** includes two priority queues **612** and **614** and the UE **620** includes one priority queue **622**. The priority queue **612** of the UE **610** has a priority higher than that of the priority queue **614**, and the priority queue **622** of the UE **620** has the same priority as that of the priority queue **612** of the UE **610**. The priority queue **612** of the UE **610** stores 100 bits of data, the priority queue **614** of the UE **610** stores 300 bits of data, and the priority queue **622** of the UE **620** stores 300 bits of data. The Node B **600** has a radio resource capable of receiving only 450 bits of data.

[0056] Referring to **FIG. 6**, the UEs **610** and **620** transmit buffer status information **630** and **632** representing the amount of data to be transmitted to the Node B **600**. That is, the UE **610** transmits the buffer status information **630** corresponding to 400 bits to the Node B **600**, and the UE **620** transmits the buffer status information **632** corresponding to 300 bits to the Node B **600**. Herein, when uplink channel conditions of the UEs **610** and **620** are identical to each other, the Node B **600** transmits scheduling assignment information **640**, which enables only 200 bits to be transmitted, to the UE **610**, and scheduling assignment information **642**, which enables only 150 bits to be transmitted, to the UE **620**.

[0057] The UE **610** determines a TFC by means of the scheduling assignment information **640**, transmits data through an EUDCH by means of the determined TFC. That is, according to a priority, 100 bits of data on standby in the priority queue **612** are first transmitted, and then 100 bits of data on standby in the priority queue **614** are transmitted. The UE **620** also determines a TFC by means of the scheduling assignment information **642**, transmits data through an EUDCH by means of the determined TFC. That is, 150 bits of data on standby in the priority queue **622** are transmitted.

[0058] Herein, although the priority queue **612** of the UE **620** has a priority higher than that of the priority queue **614**

of the UE **610**, all data in the standby state are not transmitted. That is, when there exists one UE requesting the scheduling assignment information to the Node B **600**, data in the standby state are transmitted according to priority. However, when there exists two or more UEs requesting the scheduling assignment information to the Node B **600**, there occurs a problem in that data having a higher priority are transmitted later than data having a low priority.

[**0059**] **FIG. 7** is a view illustrating a preferred embodiment of the present invention for solving the problem in **FIG. 6**. In **FIG. 7**, UEs **710** and **720** transmit not only the amount of data but also information on a priority to a Node B **700** at the same time.

[**0060**] Referring to **FIG. 7**, the UE **710** includes two priority queues **712** and **714** and the UE **720** includes one priority queue **722**. The priority queue **712** of the UE **710** has a priority higher than that of the priority queue **714**, and the priority queue **722** of the UE **720** has the same priority as that of the priority queue **712** of the UE **710**. The priority queue **712** of the UE **710** stores 100 bits of data, the priority queue **714** of the UE **710** stores 300 bits of data, and the priority queue **722** of the UE **720** stores 300 bits of data.

[**0061**] The UEs **710** and **720** transmit buffer status information **730** and **732** containing the amount of data to be transmitted and information on a priority to the Node B **700**. That is, the UE **710** transmits the buffer status information **730** containing the amount of data corresponding to 400 bits and a QID representing a priority to the Node B **700**. That is, the buffer status information **730** signifies that the amount of data corresponding to a Priority **1** is 100 bits and the amount of data corresponding to a Priority **2** is 300 bits. Further, the UE **720** transmit the buffer status information **732** containing the amount of data corresponding to 300 bits and a QID representing a priority to the Node B **700**. Herein, when uplink channel conditions of the UEs **710** and **720** are identical to each other, the Node B **700** transmits scheduling assignment information **740** and **742** to the UEs **710** and **720** in consideration of the priority. That is, the Node B **700** transmits scheduling assignment information **740**, which enables only 100 bits to be transmitted, to the UE **710**, and scheduling assignment information **742**, which enables only 250 bits to be transmitted, to the UE **720**.

[**0062**] The UE **710** determines a TFC by means of the scheduling assignment information **740**, transmits data through an EUDCH by means of the determined TFC. That is, 100 bits of data on standby in the priority queue **712** are transmitted according to priority. The UE **720** also determines a TFC by means of the scheduling assignment information **742**, transmits data through an EUDCH by means of the determined TFC. That is, 250 bits of data on standby in the priority queue **722** are transmitted. In this way, the UEs **710** and **720** can first transmit data having a high priority.

[**0063**] **FIG. 8** is a view showing a structure of a MAC-eu scheduling controller of a UE according to a preferred embodiment of the present invention.

[**0064**] Referring to **FIG. 8**, the scheduling controller **800** includes a configuration controller **804**, a priority queue (PQ) controller **802**, and a TFC selector **806**. The priority queue controller **802** receives buffer payload information **810** and **812** from priority queues, and the buffer payload information **810** and **812** represent the amount of data on standby in each priority queue. In **FIG. 8**, it is assumed that N number of priority queues exist. The buffer payload information **810** represents buffer payload information sent from a priority queue **1** and the buffer payload information **812** represents buffer payload information sent from a priority queue n. Further, the priority queue controller **802** receives queue information **814** from the configuration controller **804**. Herein, the queue information **814** is configuration information of priority queues, and it is related to the sizes and the number of memories of priority queues.

[**0065**] The priority queue controller **802** transmits a buffer status information **826** containing a QID regarding a priority of a corresponding buffer payload information **810** and **812** to the Node B through an EUDCH tx part **828**.

[**0066**] The TFC selector **806** receives scheduling assignment information **820** through a shared control channel for EUDCH (E-SCCH), a buffer status information **816** about priority queues from the priority queue controller **802**, and scheduling configuration information from the configuration controller **804**. The scheduling configuration information contains priorities of priority queues, transport format combination set, etc. The TFC selector **806** determines a TFC by means of the buffer status information **816** and the scheduling assignment information **820**. The TFC is determined so that data stored in a priority queue having a high priority is first transmitted.

[**0067**] The TFC selector **806** transmits the determined TFC to a dedicated physical data channel for EUDCH (hereinafter, referred to as a E-DPDCH) tx part **824**. The E-DPDCH tx part **824** transmits EUDCH packet data by means of the received TFC. Herein, the determined TFC is transmitted to a dedicated physical control channel for EUDCH (hereinafter, referred to as a E-DPCCH) tx part **822**. The E-DPCCH tx part **822** transmits control information containing the TFC together with the EUDCH packet data at the same time point. Also, the TFC is transmitted to the priority queue controller **802** over a scheduling information **818**. The priority queue controller **802** understands by means of the TFC the priority queue in which transmitted data has been in a standby state by means of the TFC, and renews the buffer status of the priority queues.

[**0068**] **FIG. 9** is a flowchart illustrating an operation of a MAC-eu scheduling controller according to a preferred embodiment of the present invention.

[**0069**] Referring to **FIG. 9**, in step **900**, the scheduling controller determines whether or not new data has arrived at priority queues by buffer payload information sent from priority queues. Further, the scheduling controller determines a priority queue from which the buffer payload information has been transmitted, thereby understanding the amount and priority of data transmitted to the priority queues. When the new data has arrived at the priority queues, step **902** is performed. In contrast, when the new data has not arrived at the priority queues, the process returns to step **900**.

[**0070**] In step **902**, the scheduling controller transmits buffer status information containing the buffer payload information and buffer status information containing a QID representing a priority relating to the buffer payload information to a Node B.

[**0071**] In step **904**, the scheduling controller determines whether or not scheduling assignment information is

received from the Node B. The scheduling assignment information contains information on a maximum data rate capable of being used by a UE and a permission timing. From the result of the determination, when the scheduling assignment information has been received from the Node B, step **906** is performed. In contrast, when the scheduling assignment information has not been received from the Node B, the process returns to step **904**.

[**0072**] In step **906**, the scheduling controller determines a TFC within a data rate assigned by the scheduling assignment information. In determining the TFC, the scheduling controller enables data having a high priority to be first transmitted in consideration of the priority of the data transmitted to the priority queues. In step **908**, the scheduling controller controls the data transmitted to the priority queues to be transmitted by means of the determined TFC. The MAC-eu layer generates a MAC-eu protocol data unit (PDU) containing data read from a corresponding priority queue by the control command of the scheduling controller, and transmits the generated MAC-eu PDU through the E-DPDCH. Further, the scheduling controller transmits the determined TFC through the E-DPCCH, and renews information on the changed buffer status. The renewed buffer status is transmitted through an EUDCH.

[**0073**] **FIG. 10** is a view illustrating a MAC-eu signaling between a UE and a Node B according to a preferred embodiment of the present invention. As shown in **FIG. 10**, the MAC-eu layer **1000** of the UE transmits a buffer status message to the MAC-eu layer **1002** of the Node B. The buffer status information contains a QID and a buffer payload of a priority queue as described above.

[**0074**] **FIG. 11** is a view showing a construction of a MAC-eu PDU containing buffer status information according to a preferred embodiment of the present invention. As shown in **FIG. 11**, the MAC-eu PDU includes a MAC-eu header **1100** contained in a header part and a plurality of MAC-eu service data units **1102** (SDUs) contained in a payload part. Information contained in the MAC-eu header **1100** is as follows:

[**0075**] A version flag (VF) representing the version of a MAC-eu PDU format.

[**0076**] A QID identifying of a priority queue from which a MAC-eu SDU is outputted, constructed of 3 bits.

[**0077**] A transmission sequence number (TSN) for realigning a MAC-eu SDU according to a priority, constructed of 5 to 6 bits.

[**0078**] An SID_k representing the size of MAC-d SDUs belonging to an $x^{th}$ MAC-eu SDU set from among the sets of the MAC-d SDUs constituting a MAC-eu PDU, constructed of 2 to 3 bits.

[**0079**] An N_k representing the number of MAC-d PDUs belonging to a MAC-eu SDU set, constructed of 7 bits.

[**0080**] A flag (F). When flag (F) is set to 1, the next field is a MAC-eu PDU. When F (flag) is set to 0, the next field is an SID.

[**0081**] A QID map representing an identifier of a priority queue in which data exists, and a bit number is assigned for as many as the number of priority queues. A numeral **1** represents existence of data and a numeral **0** represents absence of data.

[**0082**] A buffer payload represents the size of data stored in priority queues in which the value of the QID map is 1, and a bit number according to the length of the QID map is assigned.

[**0083**] **FIG. 12** is a view showing a structure of a MAC-eu scheduler of a Node B according to a preferred embodiment of the present invention.

[**0084**] Referring to **FIG. 12**, the scheduler **1200** includes a UE status analyzer **1202** and a resource controller **1204**. The UE status analyzer **1202** receives buffer status messages and channel status messages **1210**, **1212**, and **1214** of UEs UE#1 to UE#N located in a cell area managed by the Node B. The UE status analyzer **1202** receives buffer status information according to a priority queue contained in a MAC-eu header of a MAC-eu PDU transmitted from each UE and estimates the amount of data stored in a priority queue of each UE. Further, the UE status analyzer **1202** transmits an estimated value for the amount of data in each UE to the resource controller **1204**.

[**0085**] The resource controller **1204** calculates an ROT to be assigned to a specific UE in consideration of the estimated value for the amount of data in each UE, the channel status, and a target ROT provided from an RNC through a Node B application protocol (NBAP), and determines a maximum allowed data rate to be assigned to the UE in consideration of the priorities of the priority queues of the UE. Further, when the TFC is determined, the size of data which can be transmitted from the UE and an offset of transmission power are determined according to the TFC. The maximum allowed data rate to be assigned to the UE is contained in maximum allowed TFC information **1220** and **1222** and then transmitted to the UE by E-SCCH tx parts **1224** and **1226**.

[**0086**] **FIG. 13** is a flowchart showing an operation of a MAC-eu scheduler of a Node B according to a preferred embodiment of the present invention.

[**0087**] Referring to **FIG. 13**, in step **1300**, the scheduler determines whether or not a MAC-eu PDU containing scheduling information has been received from a UE. The scheduling information contains buffer payload information of each UE and information on a priority of each buffer. From the result of the determination, when the scheduling information has been received, step **1302** is performed. In contrast, when the scheduling information has not been received, the process returns to step **1300**.

[**0088**] In step **1302**, the scheduler determines a maximum allowed data rate to be assigned to the UE on the basis of the buffer status information and the channel status information received from the UE. The maximum allowed data rate is determined in consideration of the target ROT provided from the RNC and a priority of data to be transmitted by the UE. Further, the maximum allowed data rate is transmitted to the UE through a control channel relating to an EUDCH in step **1304**.

[**0089**] **FIG. 14** is a block diagram illustrating an apparatus for performing a transmission/reception operation by a UE according to a preferred embodiment of the present invention. First, an operation of a reception side receiving scheduling assignment information will be described.

[**0090**] Referring to **FIG. 14**, a signal received in an antenna passes through a radio frequency (RF) unit **1442**, is

converted into a baseband signal, and then is inputted to a descrambler **1400**. The descrambler **1400** descrambles the baseband signal by a scrambling code $S_{dl,n}$. The descrambled signal is sent to a despreader **1402**. In order to perform dechannelization for the descrambled signal, the despreader **1402** multiplies the descrambled signal by a channelization code $C_{es}$, and sends the dechannelized signal to a demodulation unit **1404**. The dechannelized signal is demodulated by the demodulation unit **1404** and decoded by a decoding unit **1406**. Then, an E-SCCH detection unit **1408** detects the scheduling assignment information from the decoded signal, and the scheduling assignment information contains maximum allowed TFC information **1410** assigned to the UE.

[**0091**] The maximum allowed TFC information **1410** is transmitted to a MAC-eu scheduling controller **1412** and the MAC-eu scheduling controller **1412** determines a TFC by means of the maximum allowed TFC information **1410**. The TFC is determined considering information on a priority of data on standby in priority queues **1422** and **1424**. For this reason, the priority queues **1422** and **1424** store data relating to one or more services having different priorities, and transmit a QID and buffer payload information to the MAC-eu scheduling controller **1412** periodically or whenever new data is stored. The MAC-eu scheduling controller **1412** transmits information on the determined TFC to an E-DPCCH generator **1414**. The E-DPCCH generator **1414** generates a control signal containing other control information and the TFC. The generated control signal is coded by a coding unit **1416** and the coded signal is modulated by a modulation unit **1418**. Then, the modulated signal is subjected to channelization by a spreader **1420** with a channelization code Cec and then is transmitted to a multiplexer **1438**.

[**0092**] A MAC-eu PDU generator **1428** performs two functions. First, the MAC-eu PDU generator **1428** includes the QID and the buffer status information sent from the MAC-eu scheduling controller **1412** into a MAC-eu header. Secondly, the MAC-eu PDU generator **1428** appends the MAC-eu header to the data on standby in the priority queues **1422** and **1424** by means of the TFC sent from the MAC-eu scheduling controller **1412**, and generates a MAC-eu PDU. The MAC-eu PDU is coded by a coding unit **1430** and rate-matched by a rate matching unit **1432**. The rate-matched signal is modulated by a modulation unit **1434** and the modulated signal is subjected to channelization by a spreader **1436** with a channelization code $C_e$. The channel coded data is transmitted to multiplexer **1438**. The multiplexer **1438** multiplexes signals provided from the spreaders **1420** and **1436** and signals from other channels. The multiplexed signal is scrambled by a scrambler **1440** with a scrambling code $S_{dpch,n}$ and is converted into an RF signal by an RF unit **1444**. Then, the RF signal is transmitted to the Node B through an antenna.

[**0093**] **FIG. 15** is a block diagram illustrating an apparatus for performing a transmission/reception operation by a Node B according to a preferred embodiment of the present invention. First, an operation of a reception side receiving scheduling information will be described. The reception part of the Node B has N number of reception paths **1540** and **1542** corresponding to each of N number of UEs performing an uplink packet data service. Herein, an operation of the reception path **1540** corresponding to a UE#1 will be described, but it is apparent to those who skilled in the art that the other reception paths also perform the same operations.

[**0094**] Referring to **FIG. 15**, a signal received in an antenna passes through an RF unit **1538**, is converted into a baseband signal, and then is inputted to a descrambler **1518**. The descrambler **1518** descrambles the baseband signal by a scrambling code $S_{dpch,n}$. The descrambled signal is sent to despreaders **1520** and **1522** and then is dechannelized into an E-DPCCH signal and an E-DPDCH signal. The E-DPCCH signal for which channelization has been performed by the despreader **1522** with a channelization code $C_{ec}$ is demodulated by a demodulation unit **1524**, and then is decoded by a decoding unit **1526**. A control information detector **1527** detects control information necessary in receiving EUDCH data from data decoded by the decoding unit **1526**, and the control information contains modulation information, etc., of the EUDCH data.

[**0095**] The E-DPDCH signal for which channelization has been performed by the despreader **1520** with a channelization code $C_e$ is demodulated by a demodulation unit **1528** with the modulation information detected by the control information detection unit **1527**. The demodulated signal is subjected to a rate-dematching by a rate-dematching unit **1530** and then is decoded by a decoding unit **1532**.

[**0096**] A MAC-eu header detection unit **1534** separates buffer status information in a header and data in a payload from a MAC-eu PDU sent from the decoding unit **1532**. Herein, when a QID map in a MAC-eu header has values other than 0, the MAC-eu header detection unit **1534** detects buffer status information **1516** contained in the MAC-eu header to transmit the detected buffer status information **1516** to a MAC-eu scheduler **1514**. Herein, the buffer status information **1516** includes at least one QID and buffer payload information. Further, the MAC-eu header detection unit **1534** separates MAC-eu SDUs, except for the MAC-eu header, from the MAC-eu PDU and transmits the MAC-eu SDUs to reordering buffers of an upper layer. The reordering buffers are located in an RNC, correspond to priority queues of a UE-side, and align received MAC-eu SDUs according to TSNs of the MAC-eu SDUs.

[**0097**] The MAC-eu scheduler **1514** generates a maximum allowed TFC information **1512** for each UE by means of the buffer status information **1516** and other scheduling information, and transmits the generated maximum allowed TFC information **1512** to an E-SCCH generator **1510**. The maximum allowed TFC is determined considering a priority of data contained the buffer status informaiton to be transmitted. The E-SCCH generator **1510** generates scheduling assignment information for the maximum allowed TFC information **1512**. The scheduling assignment information is coded by a coding unit **1508** and then is modulated by a modulation unit **1506**. The signal modulated by the modulation unit **1506** is subjected to channelization by a spreader **1504** with a channelization code $C_{es}$, and then is transmitted to a multiplexer **1502**. The multiplexer **1502** multiplexes the received signal together with other downlink channel signals. The multiplexed signal is scrambled by a scrambler **1500** with a scrambling code $S_{dl,n}$ and is converted into an RF signal by an RF unit **1536**. Then, the RF signal is transmitted to a UE through an antenna.

[**0098**] As described above, in the present invention, when a UE transmits data having required different priorities

through an enhanced uplink channel at the same time, a Node B control scheduling reflects the priorities of the data. For this, the UE transmits buffer status information of a priority queue corresponding to quality of service, and a Node B can perform scheduling by means of the received buffer status information of the priority queue. Accordingly, the present invention provides a differentiated service according to required priorities, thereby satisfying the requirements of users.

[0099] While the invention has been shown and described with reference to certain preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A method for reporting a status of a buffer storing packet data to be transmitted by a user equipment (UE) for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method comprising the steps of:

a) storing packet data having a priority corresponding to a plurality of priority queues relating to at least one service; and

b) transmitting buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues.

2. The method as claimed in claim 1, wherein, in step b), the buffer status information is inserted into a header part of a protocol data unit (PDU) for the uplink packet data service and the packet data is inserted into a payload part of the protocol data unit, and then the protocol data unit is transmitted.

3. The method as claimed in claim 2, wherein the buffer status information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

4. The method as claimed in claim 2, wherein the header part is a media access control (MAC) signaling header for an enhanced uplink dedicated channel (EUDCH).

5. The method as claimed in claim 1, further comprising a step of receiving scheduling assignment information corresponding to the buffer status from a Node B providing the service to the user equipment, first reading packet data having a high priority from the priority queues according to the scheduling assignment information, and transmitting the read packet data.

6. A method which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the method comprising the steps of:

generating a protocol data unit including a header part and a payload part for the uplink packet data service; and inserting the scheduling information into the header part, inserting packet data for the uplink packet data service into the payload part, and transmitting the protocol data unit.

7. The method as claimed in claim 6, wherein the scheduling information contains queue identifiers representing a plurality of priority queues having inherent priorities and relating to at least one service, and buffer payload information representing an amount of packet data stored in the priority queues.

8. The method as claimed in claim 7, wherein the buffer payload information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

9. The method as claimed in claim 6, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

10. The method as claimed in claim 7, further comprising a step of receiving scheduling assignment information corresponding to the scheduling information from a Node B providing the service to the user equipment, and first transmitting packet data having a high priority according to the scheduling assignment information.

11. An apparatus for reporting a status of a buffer storing packet data to be transmitted by a user equipment for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus comprising:

a plurality of priority queues having same priorities, for storing packet data relating to at least one service;

a scheduling controller for generating buffer status information containing queue identifiers of the priority queues and buffer payload information representing an amount of the packet data stored in the priority queues; and

transmission unit for transmitting the buffer status information.

12. The apparatus as claimed in claim 11, wherein the transmission unit comprises a protocol data unit generator for generating a protocol data unit containing a header part and a payload part for the uplink packet data service, inserting the buffer status information into the header part, and inserting packet data read from the priority queues into the payload part.

13. The apparatus as claimed in claim 12, wherein the buffer status information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

**14**. The apparatus as claimed in claim 12, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

**15**. The apparatus as claimed in claim 11, wherein the scheduling controller receives scheduling assignment information corresponding to the buffer status from a Node B providing the service to the user equipment, and controls the priority queues to first output packet data having a high priority according to the scheduling assignment information.

**16**. An apparatus which enables a user equipment to report scheduling information for a scheduling assignment of an uplink packet data service in a mobile communication system supporting the uplink packet data service, the apparatus comprising:

a plurality of priority queues having same priorities, for storing packet data relating to at least one service; and

a protocol data unit generator for generating a protocol data unit containing a header part and a payload part for the uplink packet data service, receiving packet data outputted from the priority queues, inserting the scheduling information into the header part, inserting packet data into the payload part, and transmitting the protocol data unit.

**17**. The apparatus as claimed in claim 16, wherein the scheduling information contains queue identifiers representing the priority queues having inherent priorities and relating to at least one service, and buffer payload information representing an amount of packet data stored in the priority queues.

**18**. The apparatus as claimed in claim 17, wherein the scheduling information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

**19**. The apparatus as claimed in claim 16, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

**20**. The apparatus as claimed in claim 17, further comprising a scheduling controller for receiving scheduling assignment information corresponding to the scheduling information from a Node B providing the service to the user equipment, and controlling the priority queues to first output packet data having a high priority according to the scheduling assignment information.

**21**. A Node B apparatus for scheduling an uplink packet data service from a user equipment in a mobile communication system, the Node B comprising:

a reception unit for a protocol data unit containing a header part and a payload part for the uplink packet data service;

a header detection unit for detecting scheduling information for the uplink packet data service from the header part of the protocol data unit and detecting packet data from the payload part of the protocol data unit;

a scheduler for generating scheduling assignment information for the uplink packet data service according to the scheduling information; and

a transmission unit for transmitting the scheduling assignment information to the user equipment.

**22**. The Node B apparatus as claimed in claim 21, wherein the scheduling information contains queue identifiers representing the priority queues having inherent priorities and relating to at least one service, and buffer payload information representing an amount of packet data stored in the priority queues.

**23**. The Node B apparatus as claimed in claim 22, wherein the payload information includes:

a queue identifier map representing at least one priority queue, in which the stored data exists, from among the priority queues;

an identifier of at least one priority queue represented by the queue identifier map; and

a size of the data stored in at least one priority queue represented by the queue identifier map.

**24**. The Node B apparatus as claimed in claim 21, wherein the header part is a media access control signaling header for an enhanced uplink dedicated channel.

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